TEAM LEADER AUTONOMY IN MANUFACTURING COMPANIES' NEW PRODUCT DEVELOPMENT

A thesis submitted in partial fulfilment of the degree of Doctor of Business Administration

by

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September 15, 1996

This Thesis is dedicated in loving memory of my daughter

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Abstract

Management writers have emphasised that both new product development and innovation need to be stimulated in corporations if they are to prosper (Kanter, 1983; Lawrence and Dyer, 1983; Ouchi, 1981; Pascale and Athos, 1981) and they have focused mainly on issues of marketing and organisational behaviour and only to a limited extent on job autonomy.

In the thesis aspects of team leader autonomy in new product development companies are investigated critically and empirically. The empirical study is based on data obtained from fifteen semi-structured interviews and two questionnaire surveys. The problems of managing and monitoring team leaders is discussed and conceptually represented in an improved definition of 'autonomy' originally proposed by Bailyn (1985). Autonomy is characterized in multi-dimensional terms and provides a new approach to understanding the complexity of team leader autonomy.

Following a review of the literature and a grounded theory analysis of the pilot interview data, a number of common manifestations of autonomy were identified and subdivided into 'operational' and 'strategic' components. The findings of the pilot and main questionnaire studies into the level of team leader autonomy granted by top management are reported and analysed using correspondence analysis. 'Strategic' autonomy is found to reside primarily with senior management whilst team leaders are delegated more 'operational' autonomy.

The literature on innovation cautions against too much hierarchical control but also draws attention to the top management dilemma of exercising responsibility and control of strategic tasks without stifling employees' technical competence and entrepreneurialism. A major finding from the main study is that in high technology types of company, management shares 'strategic' responsibilities with the team leader more than in other types of company. Top management cannot abrogate responsibility for directing and managing the company but, it is argued, a number of the strategic tasks could become more the responsibility of the team leader.

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ACKNOWLEDGEMENTS

In any work of this magnitude it would be rare for anyone to tackle all the tasks without the help of others, I am no exception. In particular I would like to thank both my supervisors, Professor Keith MacMillan and Dr Ashly Pinnington for their invaluable help, encouragement and guidance in this work. Special thanks also go to Professor Arthur Money for his advice on the complexities of Correspondence Analysis and to the applications expertise of Dr Sean Hammond in the Department of Psychology at the University of Surrey. I am indebted to the staff in the library at Henley Management College for their assistance in obtaining those elusive articles and to the many company managers with whom I have had contact during the research process. Finally I owe a debt of thanks to my wife for her tolerance and my secretary Mrs Beryl Robson for her keen eye for detail.

LIST OF ABBREVIATIONS

ANACOR	SPSS procedure for correspondence analysis
High Tech	High technology manufacturing companies
HR	Human Resources
ICV	Internal Corporate Venturing
Lab	Laboratory
Likert Scale	An ordinal attitude scale, typically 1-5, or 1-7
Medium to Low Tech	Medium to low technology manufacturing companies
Mgrowth	Market Growth/annum
Mshare	% of market each competitor has in total market
NPD	New Product Development
PLC	Product Life Cycle
R&D	Research and Development
RDSpend	Annual percentage of sales revenue spent on R&D
Stakeholder	Any individual with an interest in the firm and has the power to influence it
Snrm	Senior Management
Spearman Rank Correlation	Non parametric correlation
Stcom	Steering Committee
TLA	Team Leader Autonomy
Tm	Team
Tmldr	Team Leader

Chapter 1 New Product Development and Team Leader Autonomy in Industrial R&D

1.1 Introduction to Chapter

This chapter introduces the research. It starts with a brief discussion of the significance of new product development for the firm and explains why the research is important. A guide to the structure of the thesis is also provided.

1.2 The Significance of New Product Development

> 'Today's marketplace is characterized by fast paced and unremitting competition on a global scale. To survive in this environment, organizations need a level of innovation, speed and flexibility that was unheard of even a decade ago.'
>
> (Block and Macmillan, 1995, p.1)

Most organisations like to think of themselves as innovative but, according to Peters (1990), today's firms are not organised for innovation and they need to instil more of a project orientation. A commitment to innovation implies much more than merely wishing to innovate, it is a challenge to organisations to revitalise themselves so that they can successfully and continuously innovate. For example, as far back as 1968 a report published in the U.K. by the Central Advisory Council for Science and Technology (1968) examined the state of British companies in terms of the Return on Investment (ROI) obtained from scientists and engineers employed in product development and concluded that U.K. management was not sufficiently aware of the challenges facing them in the management of technology (Layton, 1972).

Since then there have been papers written about the strategic import of new product development in which it has been argued that rapid product development is a source of competitive gain (Kotler, 1976; Kanter, 1983; Porter, 1985). New Product Development (NPD) is one of the most underused functions in today's corporation. World-wide competition is increasing. With fragmenting markets and emerging technologies established companies must renew themselves continually creating wealth through the introduction of new, competitive products. Through product innovation, firms can maintain or build market share in both mature and new businesses (Dougherty, 1992 p.77). Given the thousands of new products that are developed and introduced by firms each year, only a fraction of them are sufficiently profitable to justify their development. 'Faced with staggering R&D expenses and no shortage of product failures, more and more firms are taking a critical look at their new product efforts' (Cooper, 1980, p.277).

Selecting new product development projects is one of the most difficult decision areas for the company (Danila, 1989, Fahrni and Spaetig, 1990) and is significant to the company involving a substantial investment in manpower and cash resources, and mistakes are likely to be costly. This was confirmed in the work by Cook and Roll (1989, p.252) who argued that the R&D manager needs to balance the twin problems of selecting the most promising prospects for R&D effort and expenditures with ensuring a steady flow of technically successful projects. Managers responsible for developing new products have to champion their creation and, according to some popular management writers, tend to be more frequently successful in 'excellent' company cultures (Peters and Waterman, 1982, Kanter, 1983).

The U.K.'s national technological activities and internal competitiveness remain unsatisfactory in many sectors in spite of improvements in certain aspects of economic performance. Pavitt (1990, p.17) postulates that in high wage countries such as those of Western Europe, both the competitiveness of firms and their more general welfare, critically depends on the ability of the firm to keep up in innovative products and technology. As businesses look for growth opportunities by entering new markets and introducing new products, they also need to consider ways of maximising the potential of human resources (HR). HR can be the key to effective organisation for innovation but many corporations' attempts to innovate can suffer from ineffective HR management. The productivity of R&D teams in NPD is, to a large extent, dependent on the team leader (Barczak and Wilemon, 1992) whose effectiveness (as individuals) is influenced by the type and degree of autonomy granted by top management (Hackman and Lawler, 1971; Bailyn, 1985; Raelin, 1989). Increasing corporate dependence on new products necessitates understanding how to better manage the NPD teams. Studies have found that team leadership in general is critical to success because leaders challenge and mobilise team members to work toward a common purpose (Margerison and McCann, 1990; Katzenbach and Smith, 1991; Barczak and Wilemon, 1992). It is the degree of autonomy that project team leaders have in NPD that is studied in this thesis.

1.3 Research Emphasis

This thesis investigates the degree of autonomy given by top management to team leaders in NPD. The research presented in this study has been motivated by two gaps in the literature. Firstly, according to the literature some writers have advocated that employees at most levels should enjoy high levels of empowerment and autonomy (McGregor, 1960; Ouchi, 1981; Galbraith, 1982). Whilst a considerable amount has been written about the decentralisation of decision making power and accountability to lower organisational levels, the literature has not specifically associated this with the role of team leaders at lower levels, nor the degree of autonomy granted to them by top management. Secondly, little empirical research has been conducted on autonomy related to new product development activities in the firm.

There have, however, been studies of the nature and level of autonomy given to individuals. Breaugh (1989) investigated the autonomy construct from the perspective of empirically tested work autonomy scales at a large publishing company. Bailyn's (1985) work examined the effects of both strategic and operational autonomy in industry and science, and both Bailyn and Schein (1987) discussed autonomy primarily in terms of career opportunities. Raelin (1989) has generally defined autonomy into three components, strategic, administrative and operational, but this was based on observation and experience and the author himself acknowledged it required a more rigorous empirical validation.

This thesis builds upon Bailyn's and Raelin's definitions of autonomy and represents a new approach to defining team leader autonomy. The main study is based on Bailyn's concept of 'strategic' and 'operational' autonomy as a means of measuring some common manifestations of autonomy and testing for associations with four defined company stakeholders. The stakeholder is more limited than the standard definition in the corporate governance literature and may be any individual with an interest in the firm and has the power to influence it.

Team leader autonomy data is also used to construct an 'Autonomy Map' along similar lines to that of Bailyn (1985). Her results were based on empirical work carried out on a small sample of mainly technical professionals working either in electronics or physics and within an R&D setting. It used employee self reports and was not specifically related to New Product Development (NPD). Also, there has been some disagreement about whether variables, such as autonomy, should be assessed via employee self-reports or by trained job analysts (Breaugh, 1989, p.1051). Breaugh argues further that with regard to the specificity with which to measure autonomy, it appears simplistic to suggest that any one strategy whether measuring his three facets of autonomy (work method autonomy, work scheduling autonomy and work criterion autonomy), measuring autonomy globally, or measuring overall job complexity, is correct. His view is that it seems best to have a choice among measuring devices so that one can match the measurement strategy to one's research question. He states that, 'with regard to future directions, the work by Bailyn (1985) and Schein (1987) merits particular attention' (p.1052). Bailyn (1985) proposes that 'it is important, therefore, to think of autonomy in more differentiated ways than has often been the case' (p.134) and she believes that it is important for researchers to keep in mind that variables can be independent conceptually, for example, autonomy and control, even though in the real world they may be associated. Breaugh (1989, p.1052) suggests that 'the fact that they may be correlated does not suggest that making conceptual distinctions is not important' but that greater attention needs to be given to creating a proper match between 'task requirements' and 'individuals' orientations towards having Bailyn's two types of autonomy (strategic autonomy and operational autonomy). Whilst this direction is of importance, it is even more important to first establish a more meaningful definition of the two types of autonomy appropriate to the new product development context which is the main purpose of this research.

This thesis is primarily interested in understanding 'top management's' perception of strategic/operational autonomy of team leaders rather than the employees themselves. Since it is management that decides on matters of company strategy and structures employee tasks, it is arguable that top managers are well placed to provide this data. The thesis aims to add to knowledge by defining autonomy more precisely in multi-dimensional terms and providing an insight of top management's delegation of autonomy to team leaders.

The study contributes in two ways to the understanding of team leader autonomy in new product development:

- autonomy is operationalised to provide insight into the type of autonomy granted to team leaders in new product development and examines how task responsibility is shared between four stakeholders; senior management, steering committee, team leaders and the team. Also of interest here is how R&D projects are selected. The literature suggests that normally the decisions for new product selection are either taken by groups or individuals such as a committee or by R&D managers. The research contributes to knowledge by defining autonomy in multi-dimensional terms, and clarifying who has responsibility for a number of important tasks.

- it seeks to improve on the accuracy of constructing a strategic/operational map for the team leader first proposed by Bailyn. Through redefining the terminology and enhancing the methodology used by Bailyn (and Raelin) it is possible to quantify the degree of strategic/operational autonomy granted to team leaders in NPD. This has implications for managers interested in project management issues and could be an important means of identifying areas for 'continuous development' as part of an employee appraisal scheme leading to individual performance plans. It is also a novel method of providing employees with information about possible career directions.

1.4 Team Leaders

The board is responsible for overall management and for determining the extent team leaders should be granted autonomy in NPD initiatives and has to balance autonomy with control to achieve corporate objectives. Managers nonetheless must be sensitive to how controls are applied and take account that the higher control individuals perceive themselves to have in their work, the higher their job satisfaction and, in some studies, this has been linked to improved performance (Bart, 1993; Ganster & Fusiler, 1989; Spector, 1986; Wallston, Wallston, Smith & Dobbins, 1987). According to Barczak and Wilemon's (1992, p.61) research on R&D teams the project leader has a significant impact on project performance through facilitating thinking among team members, providing critical evaluation, relaying important information, and providing boundaries within which team members are expected to work. The authors also quote Farris's (1988) work in which he found that the technical skills of the team leader contributed to the innovative performance of the project team and that those

assessed as having a moderate degree of human relations skills, developed a highly innovative team. Farris (1973) also argued that project leaders need to function as both 'captains' and 'catalysts' in order to maintain a positive performance climate.

Barczak and Wilemon (1992) show that team leaders need autonomy to make important decisions about project focus and direction and conclude that team leaders with low autonomy are likely to feel they have little control over their project (p.63).

A study by Pinto and Slevin (1988) tested the importance of factors that have long been believed to be critical to project success and found that they were significantly related to four external factors. Two of these are relevant to this thesis: characteristics of the project team leader, and, power and politics. In addition to the competence of the team leader, the amount of authority available to perform his/her duties was seen as an important factor in project success. The other two are concerned with environmental events and the perception of urgency.

NPD also involves a certain degree of individualism. Individualism includes the amount of personal freedom permitted, the extent to which an individual or collective orientation prevails and the extent to which individual interests are not subordinated to meet group goals (Morris, Avila and Allen, 1993, p.599). Having individual autonomy creates a sense of ownership of innovation and encourages risk taking, important for generating the significant persistence required to implement an entrepreneurial concept (Maidique, 1980; Drucker, 1985; Pinchot, 1985; Brandt, 1986).

Often, the team leader will have a technical background and for fast development projects such as software design or certain new leading edge scientific apparatus, must have skills in several areas. In companies working to fast development schedules, such as the computer industry where project development times can be as low as four months (Goldberg, 1994), responding to short cycles is likely to be a key factor in today's market. Hackman and Lawler (1971) discovered that jobs high on autonomy are associated with higher performance. According to Mabert, Muth and Schemner (1992), it was concluded that among other things, NPD projects need a 'knowledgeable' team leader who can devote sufficient time to plan, manage and monitor the project, often working to tight time constraints.

For the purpose of this research it is important to define what is meant by the term team leader. Much has been written about team leaders and their role. Such work discusses management and organic/mechanistic organisational design along the lines of Burns and Stalker (1961), the project management and performance of the team leader or project leader, and the power and political relationships which affect the leader. Indeed, a plethora of researchers investigated the team/project leader from one aspect or another (Kidder, 1981; Cox, 1990; Lovel, 1993; O'Conner, 1993; Tampoe

and Thurloway, 1993). However, surprisingly little of this work contains any reference or definition of what a team leader is. Tampoe and Thurloway define a project leader as:

> 'an individual manager, who works on a range of specific, one off, temporary assignments, and is responsible for the management of all, or a significant number of a project team during the course of that assignment'
>
> (Tampoe and Thurloway, 1993, p.246)

Jeffrey (1985) describes the project manager, as 'the person who is effectively in charge of the project and has sufficient authority, personality and reputation to ensure that everything that needs to be done for the benefit of the project, is done' (p.225). According to Isgar, Ranney, and Grinnell, the team leader is:

> 'the critical link between the concept of quality and its implementation through employee participation'
>
> (Isgar, Ranney, and Grinnell, 1994, p.45)

For the purpose of this research the team leader is regarded as:

> an individual who works on a specific assignment, is responsible for the outcomes of the project team and is the critical link between management and the resources available for the project.

The team leader may also be the 'champion' of new products within the organisation with attributes closely akin to the intrapreneur. Schon's (1963) view of the technical product champion was one of an individual whose range of skills covers the entire innovation process starting with R&D and through to production and marketing, and who has the administrative abilities to organise and delegate where necessary. The team leader frequently has to cross the barriers that divide the organisation along functional lines such as marketing, finance, engineering, research, sales and personnel. As team managers they have to think cross-functionally, because every department has a strategic role to play and this can mean that they have to serve as facilitators or integrators and not, as Kanter (1989) reports, as 'watchdogs and interventionists'. Sometimes the team leader has to assume a number of roles for many aspects of the business he or she wishes to develop. The team leader is generally a person that is an organised individual, is sensitive to the needs of the team and is an effective planner (Barczak and Wilemon, 1992, p.61). The ability to plan is particularly important if short lead times, expensive materials and major cross functional support is required in project development. A number of studies have demonstrated that strategic leadership helps to communicate across the discipline divide (Burns and Stalker, 1961; Mintzberg and McHugh, 1985; Kanter, 1989).

According to Roberts and Fusfeld (1988, p.317), a project leader should fulfil the following critical functions in the innovation process:

Personal Characteristics	Organisational Activities
Focus for decision making, information, and questions. Sensitive to the needs of others, recognise how to use the organisational structure to get things done. Interested in a broad range of disciplines and in how they fit together (e.g. marketing and finance)	Provide team leadership and motivation, plan and organise the project. Ensure that administrative requirements are met and provide necessary co-ordination among team members. See that the project moves forward effectively and balance project goals with organisational needs.

From the above basic profile of team leaders it is clear that they must fulfil several roles for effective innovation. They need to be recruited, managed and supported, offered incentives and supervised with the minimum of controls. However, technical professionals of this type frequently tend to be recruited, hired, supervised, monitored, evaluated, and encouraged as if their principal roles were those of routine technical problem solvers, whereas they may deserve to be selected, cultivated and managed in a special way that will stimulate creativity and achievement of corporate goals.

One of the critical issues facing management is selecting the team leader of a product development team. Team leaders in industrial organisations are critical to the success of new product development and the positional authority and the effectiveness of the team leader in companies engaged in product technology has been measured in terms of how he interfaces with the functional managers (Smith and Reinertsen, 1991, p.141). One of the major problems in achieving a higher output of new products, according to Bart (1993, p.187) is the tight control found in large corporations. He argues that conventional wisdom suggests that there need to be ways to 'loosen up' relaxing controls to allow them a greater degree of autonomy in strategic and operational tasks.

Studies in the last ten years have suggested that one of the principal deterrents to innovation and the introduction of new products is excessive management control (Peters, 1987; Quinn, 1985). Such an argument appears to be supported by the work done by Bart (1993) in which he noted that in three cases where low output of new products were studied, business unit managers appeared to be erring by not giving their subordinate managers sufficient latitude and elbow room on their new projects. At the same time, according to Bart (p.195), for low output, unrelated, imitative and incremental new product projects, the business unit managers did not appear to be providing enough control and seemed in fact, to be giving their subordinates too much freedom. This is an interesting finding in his research because it suggests that too little control can be just as damaging as too much. The relationship between autonomy and control is discussed further in chapter three.

1.5 Team Leader Autonomy

The management literature contains a thematic emphasis on participation and participative style. McGregor (1960), Likert (1961), Ouchi (1981), Kanter (1983), Bennis and Nanus (1985) and Handy (1985), all support participative methods as being more appropriate to the management of skilled workers. Kanter, for example, states that:

> 'the term participation is being used here to mean involvement in a team with responsibility for a joint product ... Participation is equated with teamwork, and participative management with the building and nurturing of a collaborative team that is more fully consulted, more fully informed than the ordinary one that shares responsibility for planning and reaching outcomes'
>
> (Kanter, 1983, p.410)

Kanter's definitions of participation and participative style are illustrative of the participative management approach emphasising the autonomous responsibility of teams, itself a theme evident in research on professionals (Smigel, 1964; Alchian and Demsetz, 1972; Friedson, 1986; Maister, 1985; Shapero, 1985; Thamhain and Wilemon, 1987; Tolbert and Stern, 1991). It follows from definitions like Kanter's that excessive supervision and control by executives from outside the team could potentially demotivate and be destructive of the team's goals because such actions are contrary to Kanter's principle of participation. The views expressed by these authors suggest that bureaucratic practices and tight management control could have an adverse effect on NPD teams, in particular their ability and willingness to perform; a point also made by Bailyn (1985, p.130) who further articulates that there is sometimes a conflict between employer and employee over the level of supervision required.

Bailyn (1985, p.130) argues there is a misunderstanding of the meaning of the term autonomy in the industrial research community, deriving from the assumption that R&D employees are similar to the academic scientist who is guided solely by the curiosity and inclinations of the individual. Bailyn claims that in the industrial laboratory, the prevailing work practices derive from the fact that scientists function best when they are left alone to get on with the project in hand. In an industrial setting, team leaders, for example, typically look for as much autonomy as they can get, whereas in academia science brings its own rewards and is an activity pursued for its own sake, needing no other recognition.

It is this combination of inter-independence and autonomy and its impact on performance that is important for management to understand. This thesis includes an examination of the issues of task autonomy and control in New Product Development against a background of some company internal and external variables in order that we may examine whether these variables play a role in determining the degree of team leader autonomy present.

1.6 Research Stages

Following an extensive review of the literature, the research for this thesis consists basically of four stages: pilot interviews, a grounded theory, a pilot survey and main study. The first stage consisted of constructing a set of broad research questions to be used as a basis for the semi-structured interviews. In-depth interviews were conducted with 15 practitioners responsible for new product development projects. The second stage consisted of an examination of the interviews using the 'grounded theory' methodology (Glaser and Strauss, 1967). Analysis of the interview data permitted a refinement process which helped in the design of a survey research instrument for the third stage, the pilot survey. At this point a decision was made to concentrate on team leader autonomy rather than the 'intrapreneur' as was the original research intention, the reasons for which are given at the end of chapter four. The results of the stage three pilot survey led to a further refining of the survey research instrument for the fourth stage, the main study.

1.7 Limitations of this Thesis

There are several limitations to this study that need stating. Firstly, whilst this work is related to entrepreneurship, it does not go in any depth into the process of entrepreneurship. The process of entrepreneurship as described by van de Ven (1986, p.226) is 'a collective achievement requiring key roles from numerous entrepreneurs in both the public and private sectors'. Under these conditions it would be necessary to take the inter-organisational community or network as the relevant unit of analysis. Secondly, it does not examine any underlying reason for the level of autonomy given other than those associated with the selected variables. Whilst the issues of management control, employee skill levels and managerial competence are considered, there is no in-depth inquiry of these subjects, neither does this work consider career objectives, nor other psychological or sociological factors. This would be the subject of different research and is beyond the scope of the thesis. Thirdly, the subject of autonomy is a very complex issue and is examined in chapter three, but the empirical work does not systematically investigate different disciplinary concepts of autonomy.

This research confines itself to investigating the extent of team leader autonomy measured in terms of some organisational manifestations of autonomy in electrical/electronics manufacturers and control systems design. Fourthly, there is no account taken of the degree of power exercised by managers, at the top, middle or lower level of management. The power model referred to here is that advanced by Salancik and Pfeffer (1988, p.179) which is an elaboration of what has been termed 'strategic contingency theory', which holds that power is something that accrues to organisational subunits (individuals, departments) that cope with critical organisational problems. Individuals use power to ensure their own survival through the control of critical resources. However, power is generally shared in organisations, generally out of necessity more than out of concern for principles of organisational development or participatory democracy. According to Salancik and Pfeffer (1988), 'power is shared because no one person controls all the desired activities in the organisation' (p.183).

This thesis concentrates on autonomy and does not investigate in any great theoretical or empirical depth the issues of power. A further limitation of this thesis is that it does not take the 'culture' of the organisation into account.

1.8 Overview of the Thesis

The original research intended to address the issues of intrapreneurship and how the degree of autonomy granted to the intrapreneur might assist corporate growth through the growth of new businesses. However, the emphasis of this work was changed after the pilot interviews in favour of team leader autonomy. The explanation for the change is dealt with in chapter four. The pilot and main study both focus on team leader autonomy against a background of company internal and external market variables.

Chapter 1 introduces the research focus on the team leader and autonomy, the research stages and discusses the limitations.

Chapter 2 reviews the literature on new product development, innovation and entrepreneurship. There is a discussion of how firms see product development as a source of competitive gain. Differences of approach to new product development in the United States and Japan are compared and the chapter examines new product success and failure as well as some of the environmental conditions within which companies operate. This section also looks at the concept of innovative new product development and discusses technical innovation.

Chapter 3 continues the literature review and examines the subjects of de-centralisation, empowerment and autonomy, and defines what constitutes strategic and operational autonomy. Autonomy and control are operationalised and we look at the relevance of job autonomy and control studies to team leaders. The work of Bailyn and others is discussed and the concept of 'strategic' and 'operational' in the context used in this work is explained.

Chapter 4 discusses the different methodologies typical to business research and considers the approach most appropriate to each research philosophy. The first phase of the pilot study is discussed along with a summary of the literature on intrapreneurship. It continues with the findings of 15 semi-structured interviews in companies.

Chapter 5 discusses further evaluating the qualitative data obtained during the depth interviews and how, through the use of grounded theory, one is able to inductively derive core categories suitable for use in the pilot and main studies. It describes how category data is established and how it relates with the task variables used in the empirical research

Chapter 6 describes the research method used in the pilot survey and how bias may be kept to a minimum. There is a discussion of the postal questionnaire used for the second phase of the pilot study.

Chapter 7 discusses the pilot study questionnaire and presents a summary of the findings including suggestions for the next stage of the research.

Chapter 8 describes the samples used and the changes made to the main study questionnaire. Response rates are described and a breakdown of companies by industry sector, sales volume and product markets is given and the main findings are presented.

Chapters 9 and 10 provide the interested reader with further analysis of the U.K. sample indicating possible determinants of team leader autonomy. A comparison is made between two similar samples in the U.K. and U.S.A. The findings of the Bailyn (1985) autonomy map are discussed and a set of underlying patterns of project issues are examined. These chapters are additional and subsidiary to the main arguments of this thesis but may be of interest to those researchers wishing to do further study in this area.

Chapter 11 provides a discussion about the main aims of the thesis, reviews further limitations and reviews the main findings of the research. The chapter produces a set of conclusions and explains the autonomy map as originally conceived by Bailyn (1985).

Chapter 12 discusses some of the highlights of the research findings and suggests a list of areas for future research directions. One area of specific note is the suggestion to conduct further research into a possible link between some product market variables and the degree of autonomy granted to team leaders.

1.9 Summary of Chapter

This chapter has introduced the topics of new product development, innovation, team leaders and autonomy. The underlying reasons for undertaking this research have been identified and consideration given to the issues involved in new product development and the concept of autonomy. There has been a brief overview of the chapters in the thesis.

Chapter 2 New Product Development (NPD)

2.1 Introduction to Chapter

The chapter considers approaches to NPD, discusses intrapreneurs and innovation. It looks at how ideas are managed into good currency and how companies organise and manage innovation.

> 'It is mainly, but not exclusively, large companies that develop inflexible, mechanistic forms that can inhibit the actions of in-house entrepreneurs and impose a damper on innovatory activities'
>
> (Rothwell, 1992, p.228)

2.2 New Product Development

For the purpose of this study, New Product Development (NPD) may be described as the discovery and development of new technological products which fit customer needs. 'Everything that a business does, must be pointed at the market. Every business function must be directed toward and be in tune with the market' (Keener, 1960). This statement by the then president of B. G. Goodrich, was made over 30 years ago and is as true today as it was then. Businesses ignore the market at their peril and over the many years since then, there have been many writers in the management field who have repeated this advice (Pascale and Athos, 1981; Peters and Waterman, 1982; Lawrence and Dyer, 1983; Kanter, 1983, 1985, 1987; Peters and Austin, 1985; McKinney and McKinney, 1989; Capon, Farley, Lehman and Hulbert, 1992). Cooper (1980) postulates that among several issues considered to be important to the successful launch of new products are market factors: the intensity of market need, market growth rate and market size, and Dougherty (1992, p.77), argues that through product innovation firms can maintain or build market share in both mature and new businesses.

The strategic need for new product development has been examined by Foxall (1984) who says there is a need to accommodate the new product development process at each stage to the strategic mode of the enterprise. This can be expressed in terms of a contingency model of the firm's strategic response to the external environment and its capacity to match its innovative activity to that environment. It is the strategic group and the strategic market which defines the competitive battleground. The strategic group is determined by classifying together companies with similar strategies (Kay, 1993, p.128). Foxall says that given the right conditions, the firm should develop those innovations which are strategically necessary to attain its overall desired economic objectives. He further declares that the vast majority of new product launches comprise product modifications and improvements which accommodate the basic product concept more closely to the needs of the market place; a theme repeated by other researchers (von Hippel, 1977; Fast, 1979; Peters and Austin, 1985; Henderson and Clark, 1990).

New product development (NPD) is frequently the result of an agreed competitive strategy, described by Porter (1985) as the search for a favourable market position in an industry, the fundamental arena in which competition occurs. Porter (1985, p.1-2) advances two central questions underlining the choice of competitive strategy. First, is the 'attractiveness' of industries for long term profitability and the factors that determine it. Secondly, there are the determinants of relative competitive position within an industry. Innovativeness he says, is important for competitive advantage in all industries and key to some: in the computer industry, for example, having the fastest processor or access to it can lead to significant product enhancements.

According to Rothwell (1992, p.224), success is 'people centred'. Formal management techniques can enhance the performance of competent managers, but they are no substitute for management of high quality and ability. Innovation is essentially dependent on individuals and group processes, and simply attempting to substitute formal management techniques for managerial talent and entrepreneurial flair is not an option. Rothwell believes innovation is an activity where people must interact in order to produce a commercially viable product and that each have a role to play (a point made earlier by Galbraith, 1982).

Failures of planned new products are frequent. Quinn (1985, p.73), writing about the management of innovation argues that for every new solution that succeeds tens of hundreds fail. The sheer number of attempts, he says, most by small scale entrepreneurs, means that some products will survive, but the high percentage that fail are distributed widely throughout society and receive little notice. Block (1981, 1995) argues that failures are often due to the misapplication of management methods that are successful for operating companies starting new businesses. Block (1981) describes one Fortune 500 company that has a failure tolerance of 80 percent of all new business ventures and one large multinational company reported eighteen failures with no successes to date - a poor record, and not an isolated case, indeed there is an identifiable body of literature on failed ventures (von Hippel, 1977; Hill and Hlavacek 1977; Fast, 1979; Block, 1981). Fast (1979) conducted a survey of firms that had created a separate 'New Ventures Division' to facilitate internally developed products. He concluded that the position of many of these new divisions was very precarious. Several were short-lived and most of the others suffered dramatic changes as a result of inconsistent corporate strategy. In their book 'A Passion for Excellence', Peters and Austin (1985, pp.212-216) discuss the prospect of failure in the context of innovation and new product development. They advocate the acceptance of failure up to a point arguing that to be a supporter of failure is not to say one supports slipshod performance. They talk of good tries that fail, well-planned good tries from which one explicitly learns something quickly. They advocate 'constant tries are the simple watchwords of innovation' (p.213); most fail.

The pilot research into team leadership in this study also confirms that contrary to popular belief there is very little top management tolerance of failure at the middle management level. In a cross

section of industries from computer manufacturers to pharmaceutical companies, the pilot interviews found 'failure' is a word that does not sit well with upper management in corporations.

There are some country or national differences in approach to new product development. For example, new product development in the United States and in Japan, differ fundamentally in three aspects:

i) U.S. companies view the process as more analytical and systematic, whereas the Japanese view product development as a trial and error process (learning by doing) and resort to a considerably looser format of phase management. According to Rothwell (1992, p.225), the Japanese put the emphasis on interdisciplinary teams involving marketing, manufacturing and R&D, with the maximum sharing of information across functions. This ensures that customer needs remain the focus of R&D activity and that products are developed that can be efficiently and reliably manufactured. Later in the research we shall look for evidence to demonstrate the more analytical and planning nature of NPD in the U.S.A.

ii) In the U.S. product development is undertaken by highly competent and innovative groups of specialists where the learning is done by an elite group of technical people, largely on an individual basis, in a very narrow area of expertise. By contrast, in Japan, product development is often done by teams of non-experts who strive to become generalists through interaction with each other during the development process.

iii) New product development in the U.S. is an important strategic tool to enable companies to adapt to changes in the external environment by taking advantage of market opportunities. In Japan it is used to stimulate change reshaping corporate culture. Product development helps to break down the hierarchy and rigidity of Japanese organisation (Ken-ichi Imai, Ikujiro Nonaka, and Hirotaka Takeuchi, 1988).

Blanchard (1989) describes the unpredictability of producing innovative products and recommends management be flexible to change, unpredictable timings and applications of new ideas. Blanchard further argues that this can be attained variously through small independent groups, business units, or within an organisation-wide campaign. For NPD to work in a company, he says, it must be openly supported.

2.3 Intrapreneurship

Prior to the pilot survey this research was intended as a study of the autonomy granted to the Intrapreneur and thus formed the design of the interview schedule, therefore a brief discussion about Intrapreneurs and Intrapreneurship is considered appropriate. The expression *intrapreneur* was first

coined by Pinchot (1985) and modified from the word entrepreneur. Intrapreneurs, like entrepreneurs, are not necessarily inventors of new products and services. Their main function in life is to take embryonic ideas or working prototypes and turn them into profitable business. Although the term was new the concept had already been widely in use in other forms (corporate venturist, internal corporate entrepreneur, corporate entrepreneur) for decades. An antecedent of the term intrapreneurship was used by Schon (1963). Writing in the Harvard Business Review (HBR) his article "Champions for Radical New Invention" referred to product champions. He suggests that one solution to the problem of overcoming the acceptance of innovation in traditionally run corporations lies in the encouragement of "champions" for new ideas. Schon states that:

> 'it is a characteristic of champions of new developments, that they identify with the idea as their own and with its promotion as a cause, to a degree that goes far beyond the requirements of their job'
>
> (Schon, 1963, p.84).

This view is also supported in the work by Manz and Sims (1989). One of the factors which underlines the need to encourage internal entrepreneurship (intrapreneurship) is well covered by the work done at Sussex University by Rothwell (1974) on project 'SAPPHO' phase II who says that it is the increasing degree of concentration in industry, in particular the science based industries, where the need for innovation is greatest. He quotes several novel organisational forms which have been adopted with the express purpose of creating an environment conducive to intrapreneurship.

Burgelman (1984) believes that new managerial approaches need to be developed and innovative administrative arrangements set up so that internal corporate venturing (ICV) or intrapreneurship and the rest of the organisation cooperate effectively. He proposes that most managers in established firms will probably agree that ICV is an important avenue for corporate growth and diversification.

The description of the entrepreneur has a long history dating before management became an academic subject. An early definition of the entrepreneur came in 1755 by Cantillion, a French writer, who stated that an individual is a rational decision maker providing management for the firm and who assumes risk. John Stuart Mill's (1848) use of the term is consistent with Cantillion. Mill ascribed risk-taking to be a trait of the entrepreneur as indeed did Schumpeter (1934) who characterized risk as an indicator of entrepreneurial behaviour. In latter years several writers in business journals have given their support to the various characteristics which best describe entrepreneurs. Stevens (1991) believes that small business entrepreneurs should take prudent risks and that new challenges should carry a manageable level of risk. According to Baumbach and Mancuso (1984), entrepreneurs enjoy administrative freedom to do as they wish within the constraints of their financial limitations and are self-reliant and goal oriented. In general they know the business they are in intimately and often possess more business acumen than managerial skill.

Pinchot (1985) describes the intrapreneur as a person characterized by such attributes as initiative, flexibility, leadership, hard work and motivation, is subject to corporate culture and usually found in a corporate environment. The intrapreneur generally takes hands-on responsibility for creating innovation of any kind within the organisation and displays managerial and risk taking qualities that might promote the establishment of operations outside the company if the needs and wishes of the individual are not reconciled within the firm. Having said this, Pinchot (1985) also argues that intrapreneurs like entrepreneurs are not necessarily inventors of new products and services. They may just take embryonic ideas or working prototypes and turn them into a profitable business. Once they have seen the project through to a point where they can hand it over to the production and marketing people, they are likely to become bored and will seek new areas of interest. Pinchot (1987) further states that an intrapreneur's imagination is quite different from an inventor's.

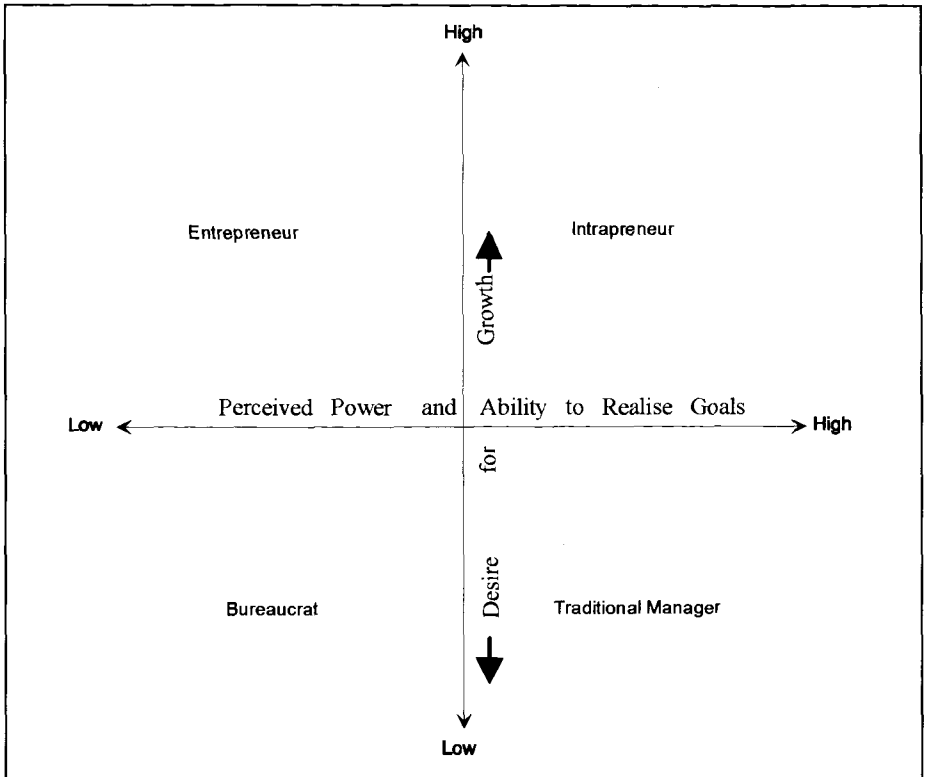


Figure 1: 4 Quadrant Management Opportunity Matrix

(adapted from Stevenson and Gumpert, 1985, p.86)

Traditional management styles may vary from that of a bureaucrat to that of a traditional manager. Figure 1 depicts a 4 quadrant opportunity matrix with two axes having values ranging from low to high in both planes. In the bottom right quadrant of figure 1, the traditional manager often has the power to realise goals, but very little desire for growth. In the bottom left quadrant, the bureaucrat has neither the desire for growth nor the perceived ability to realise goals. Stevenson and Gumpert (1985, p.86) regard these individuals as 'trustee types' who feel threatened by change and the unknown and

often rely on the status quo. Bureaucracies were created with the management skills targeted to administering large scale concerns in relatively stable conditions. So long as growth in the core business continued at an acceptable rate of return there seemed to be no need to change.

Typically the intrapreneur has a positive desire for growth and a perceived ability to realise goals (Pinchot, 1985) usually brought about by the wish to create new opportunities and be innovative. Figure 1 shows various levels of intrapreneurial activity in the top right hand quadrant. The top performing intrapreneur is high on both axes.

The intrapreneur needs good interfacing skills between top management and the innovative group. Managers of an innovative work group must often create a new order by working with new teams of individuals and mould them into a new cohesive unit (Kanter, 1983). Learning to understand the close tie between the technical and administrative dimensions of innovation is a key part of understanding the management of innovation. Often the intrapreneur is the person who coordinates the marketing, production and development functions guiding the project from its infancy through to completion and market launch. He/she will act as protector guarding the innovation from hostile influences and provide the impetus to keep the project on schedule.

Bureaucratic management, on the other hand, is inherently preservation seeking. Bureaucrats seek to retain the status quo as opposed to the intrapreneurial style of management that seeks opportunities to exploit wherever they may occur and by whatever means at their disposal. Based on US and some UK research (Peters and Waterman, 1982; Kanter, 1983, 1985, 1987; Pinchot, 1985; Rothwell, 1987 and Manz and Sims, 1989) it can be said that the corporation gains value from the intrapreneur.

2.4 Innovative NPD

Quinn (1985, p.81) describes some of the new product innovations in the U.S. Hewlett Packard and 3M develop product lines around a series of small, discrete, free standing products: 'These companies form these units to look like corporate venturing start-ups'. Management looks at different proposals and encourages them to be tested in the market place at the earliest opportunity in order to get customer feedback. Some larger corporations such as AT&T have to make much larger investments to last for decades. These corporations tend to make long term forecasts and test new innovations extensively before committing themselves on a world-wide basis. They frequently sacrifice speed of entry for the longer term, low cost and reliability. Effective innovation thus stems from active awareness of the changing user needs as well as from the direct product/service user demands for a solution to a given problem. Several researchers such as Utterback (1978) and von Hippel (1988) have studied high tech companies and analysed the degree of customer contact/input among better-performing companies and conclude that there is a substantial synergy to be derived.

Damanpour (1987) views innovation as the implementation of an idea for a new product or service and West and Farr, define it more broadly as:

> 'the intentional introduction and application within a role, group or organisation of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organisation or wider society'
>
> (West and Farr, 1990, p.9)

Invention and innovation have been taken to mean the same thing, but there is an important distinction to be made between the two concepts. Rickards (1985, p.10) defines invention as a 'discovery', usually a technical one, whereas innovation is best described as a 'process where new ideas are put into practice'. Entrepreneurial innovation has, at its roots, the creation and exploitation of new ideas departing from the established routines or systems of the firm. Today, the question of 'needs pull' versus 'technology push' has become less of a live research issue, says Rickards (1985, p.20). Many managers would like to know what causes innovation. Rickards argues that the way this question is framed suggests a belief in a simple chain of events leading from a bright idea to a commercial product, or that there is a powerful market force that needs to be satisfied. This, he says, fails to address the real meaning of innovation. Quinn (1985) argues that the innovation process is knowledge intensive, relying on individuals.

Garnsey and Wright (1990) discuss three routes to technological innovation: in-house innovation in large companies through organisational modifications, off site innovation, which is administratively independent, but still integral to, the large organisation, and circulation of key innovators. They argue against distinguishing pre-competitive from near market R&D, proposing that the process is iterative and requires empowerment of employees concerned with making the technological breakthrough, continuity of membership in innovative teams, and top level support and involvement at every stage. They identified that large companies, small companies, universities and individuals all have different contributions to make to collaborative projects. Large companies, for example, are typically run in such a way as to minimise uncertainty, to increase control over internal activities, and to promote efficiency through increasing specialisation of tasks and functions. However, most attempts to reduce the uncertainty tend to increase direct control and achieve efficiency through specialisation and co-ordination through the hierarchy which can give rise to a variety of problems for product innovation at every phase of development. Despite their reluctance to distinguish fundamental from near-to-market research, the authors describe the potential contribution of the collaborators according to the stage of innovation; through speculative investigation, initial development, growth phase to full exploitation. They propose transferring staff between institutional boundaries to stimulate innovation, preferring it to initiatives such as company internal re-organisation. There is, however, considerable evidence of the importance of organisational variables

and their contribution to the R&D process and furthermore there are political, economic and institutional obstacles to the free flow of innovative project teams between organisations which Garnsey and Wright (1990) acknowledge. They believe that there is general agreement that innovation strategies capable of generating new technically based products and processes are essential for many companies faced with current market conditions. However, they conclude, stimulating effective innovation in large companies characterized by formal organisational procedures and established structures, which aim at differentiation of functions and specialisation of roles, is particularly difficult.

According to van de Ven (1986) research on innovation has concentrated more on entrepreneurial management of the process and he describes innovation as the development and implementation of new ideas by people who, over time, engage in transactions with others within an institutional order. The author focuses less on organisational structure and more on developing a broad framework for creating and implementing innovation. He offers four central factors:

> '(i) The human problem of managing attention-triggering people's action thresholds. Human beings have a limited capacity to handle complexity and maintain attention.
>
> (ii) The process problem of managing ideas into good currency- implementing and institutionalising ideas into gaining mainstream acceptance by people of different individual backgrounds and experience within the organisation.
>
> (iii) The structural problem of managing whole part relationships - using specialist multiple functions, resources and disciplines to transform innovative ideas into reality. Integrating the specialist perceptions, frames of reference and resources into a whole.
>
> (iv) The strategic problem of institutional leadership - creating an infrastructure conducive to innovation which involves the inclusion of broad cultural factors and resources provided by law, government regulations, knowledge distribution and resources. Institutional leadership is crucial for creating a cultural context that fosters innovation.'
>
> (van de Ven, 1986, p.590)

The first two factors stress the role of the individual and groups of individuals in the innovation process and the last two factors take a broader granularity of analysis, the part-whole dynamic relationship within organisations and lastly, the role of institutional leadership in fostering and nurturing innovation. In a later article by van de Ven (1993), institutional leadership is further stressed in that institutional legitimation of a new technology is fundamental to the efficient operation of the market mechanism (p.216). When there is high uncertainty about the safety of a new product, for example, a bad reputation of a poorly designed product can drive the high quality product out of the market. A common manifestation of industry legitimation is the setting of technical standards

relating to component specifications, processes and performance criteria which designs of a new technology product are expected to achieve. Technical standards are a powerful institutional mechanism for selecting dominant designs from among competing technologies.

According to the literature review by Barclay (1992, p.307), the process of developing new products involves a wide range of influencing factors that interact in an extremely complex way. The process is both difficult to define and model other than in a simple, procedural form. A paper by Rothwell (1992, p.232) describes some of the important research undertaken on innovation during the last 30 years. He suggests that technical innovation in the 1950's was regarded as a more or less linear process starting with a scientific discovery and passing through industrial R&D, engineering and manufacturing and ending up in the market place. There was a technology 'push' in place at that time, but by the mid 1960's, the market 'pull' effect began to take over. The strategic focus shifted from marketing in the early 1970's to a cost focus up until the early 1980's. During what Rothwell refers to as the fourth period from the early 1980's to 1990, the situation appears to become somewhat more complex, with a broader combination of central strategic theme: 'diversification; technological accumulation; inter-firm collaboration and global strategies'.

Rothwell postulated that during the 1990's, the following themes would be likely to come to the fore:

(i) inter-firm integration (networking)
(ii) technological accumulation (technology strategy)
(iii) integrated product and manufacturing strategies (design for manufacturability)
(iv) flexibility (organisational, product, manufacturing)
(v) product/quality/performance
(vi) the environment
(vii) speed to market

Of the themes proposed by Rothwell the following are considered in this work: (iv) organisational flexibility, (vi) the environment and (vii) speed to market. This thesis significantly addresses only the organisational level and the environment, and acknowledges the potential limitation this has for the generalizability of the research findings. According to Rothwell (p.234), being a 'fast' innovator has emerged as an important factor for corporate strategic consideration. Among the factors he lists as contributing to shortening of time to market are intensifying competition and the rapid rate of technological change, for example, in areas like electronics. Of the factors identified as influencing speed to market he gives the efficient handling of indirect development activities such as project control, project administration and general co-ordinating activities which can comprise up to 50% of the total project time. Clearly, he says, actions that render these activities more efficient have significant potential for reducing development times.

Galbraith (1982) proposes that every innovation starts with an idea generator or idea champion. As with other organised phenomenon, innovation is brought about through the efforts of people who interact in a combination of roles. Innovation is not an individual pursuit and people must interact to produce a commercially innovative product. The idea generator is usually an employee outside of top management who experiences a problem and develops a response to it. Team Leaders of NPD projects can be idea generators. Idea generators are also widely sought in 'Corporate Venturing'. According to Block and Macmillan (1995, p.77), companies seeking to stimulate the flow of ideas need to ask themselves questions such as: 'What does it know a lot about? What skills, intellectual capacity, technology, market position and market information and organisational skills does the company have that can form the basis for a new business?'

Once the idea has been appreciated as an opportunity, someone has to supply the necessary energy to mobilise organisational resources and support. The problem, therefore, facing the idea generator is how to attract the interest of the key people in the company. Amabile (1988, p.124) observes that 'in the industrial sector, there is still no comprehensive model of how the process of innovation occurs and what influences it', although she does propose there is a general acceptance that innovation embodies the 'generation, acceptance and implementation of new ideas, processes, products, or services' (p.126).

Schon (1971) focuses on the social-political dynamics of the innovation process and emphasises the centrality of ideas as the gathering point around which collective action mobilises. He argues that the central locus of ideas provides the common ground for what might otherwise be seen as isolated, disconnected or competitive persons and stakeholders contributing their unique frames of reference to the innovation process.

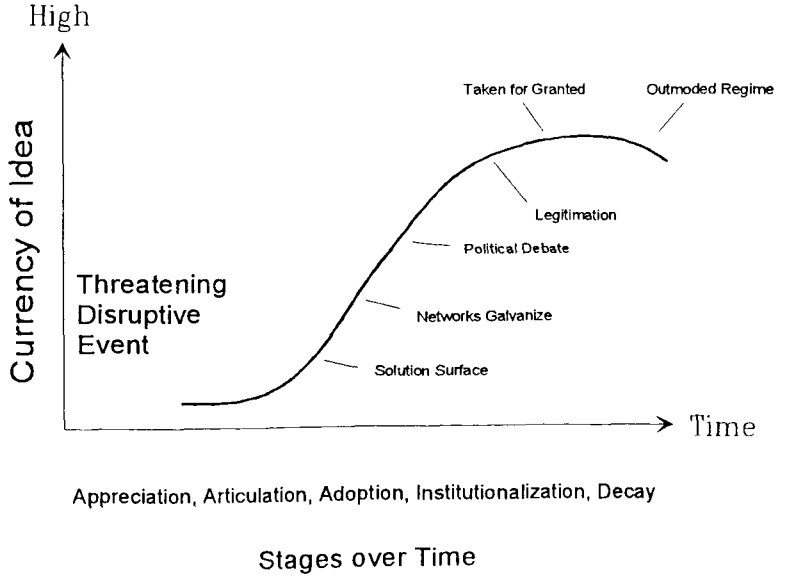


Figure 2: Managing Life Cycle of Ideas in Good Currency from Schon, D (1971)

The respective roles of technological innovation and organisational environments are central themes of the innovation literature and are often traced back to Schumpeter (1934). Henderson and Clark (1990) distinguish incremental changes that are common in innovative product design from radical innovation requiring a new core design embodied in components that are linked together in a new architecture. Tushman and Anderson (1986) characterise innovation in terms of technological discontinuities and organisational environments (industry markets). Radical changes in innovation generally mean technological breakthroughs that either enhance or destroy the competence of firms in an industry. These breakthroughs or technological discontinuities significantly increase environmental uncertainty or *munificence*, referred to by Tushman and Anderson (1986, p.445) 'as the extent to which an environment can support growth'. The authors believe that environments pose constraints as well as opportunities for action and if one accepts that organisational outcomes are critically influenced by the context in which they occur, then better understanding of organisational dynamics requires that we more fully understand the determinants of environmental change. Environmental conditions are likely to be shaped by competitive, legal, political and technological factors and the interplay between them (p.439)

2.5 Organisational Innovation

Damanpour's (1991) study of innovation was informative in that it compared factors which can inhibit or enhance organisational innovation. Damanpour's article conducts a meta analysis of organisational studies distinguishing between diffusion and adoption, and innovating and innovativeness. The meta analysis focuses on the adoption of innovations in organisations and examines the organisational properties that enhance or hinder organisational effectiveness. The study concentrates on the effects of 13 organisational determinants which are mainly structural variables, but include process, resource and cultural variables. The 13 independent variables identified are: *specialisation, functional differentiation, professionalism, formalisation, centralisation, managerial attitude toward change, managerial tenure, technical knowledge resources, administrative intensity, slack resources, external communication, internal communication and vertical differentiation.* He hypothesised a positive relationship for eleven of the thirteen organisational determinants to innovation. The degrees of formalisation and centralisation were hypothesised as organisational determinants possessing a negative relationship to innovation. Damanpour's reasons for this hypothesised relationship for formalisation included reference to studies arguing that flexibility and low emphasis on work rules facilitate innovation (Burns and Stalker, 1961; Thompson, 1967; Aitken and Hage, 1971). On centralisation, he cites Thompson's (1961) work arguing that dispersion of power is necessary for innovation to work. The studies included in Damanpour's work had all researched the rate of adoption of at least two innovations in organisations or 'organisational innovativeness' where organisations were the unit of analysis and not the individual or populations of organisations. The meta analysis found a negative association between innovation and centralisation, non significant associations between innovation and formalisation, managerial tenure and vertical

differentiation; the other variables were positively related as predicted. The results suggest that the relations between these determinants and innovation are more stable than some researchers have asserted. Damanpour's analysis indicated that type and scope of organisation were more effective moderators than the type and stage of innovation. Damanpour concludes that research is recommended on the use of the eight determinants of innovation (specialisation, functional differentiation, professionalism, managerial attitude toward change, technical knowledge resources, administrative intensity, slack resources, external communication and internal communication). He hypothesises there is a misplaced emphasis on non significant determinants (e.g. formalisation, managerial tenure, vertical differentiation) and the negative determinant over centralisation of decision making authority. It is the last of these - over centralisation - that is a particular focus in this work.

In a brief article summarising changes in the field of R&D management over the past 20 years, Allen and George (1989) propose ten desirable research goals for the management of technology. Amongst others, they recommend researchers seek to better understand the role of technology in corporate strategy, learn how to organise for greater technological flexibility, understand the factors leading to reduced product development time, improve understanding of the management of large, complex and interdisciplinary or inter-organisational projects, increase the effectiveness of technical professionals and improve understanding of the conditions promoting and inhibiting intrapreneurship. The main argument and theme of Allen's (1977) research is that in order to improve R&D productivity and performance, communication must be managed properly, particularly the co-ordinating and sharing of information and the continual maintenance of technical currency. Related to the issue of technical currency, there is some research evidence for the critical role played by technical competence in supervising innovative R&D work. Allen and George's (1989) research agenda for managing innovation is broad and this research focuses on just two of the recommendations, understanding factors leading to reduced product development time and entrepreneurship/intrapreneurship.

2.6 Project Structures

This research is concerned with project team leaders thus it is useful to examine Larson and Gobeli's (1988) definition of the project team structure which they describe as, 'A project manager is put in charge of a project team composed of a core group of personnel from several functional areas and/or groups, assigned on a full time basis. The functional managers have no formal involvement' (p.181). Larson and Gobeli's research on organising product development projects is based on an empirical study of over 500 managers in which they were asked to evaluate a specific development project according to project cost, schedule, and technical performance indicating which structure was used to complete the project.

The respondents were given a choice of the following structures:

Functional

Functional Matrix

Balanced Matrix

Project Matrix

Project Team

Overall, managers rated by around 50% the project team as the most effective approach for meeting schedule, controlling costs and technical performance whilst Allen (1977, p.212) concludes in his book *Managing the Flow of Technology* that specialists in a team reporting to a single project manager working in a single physical location, best accomplish multi-disciplinary projects. The authors cite a summary by Crawford (1986) that no one structure is inherently superior to any other and that the choice of structure to use when planning projects depends on assessing the relative advantages and disadvantage of the different options against the requirement and objectives of the project. The literature appears to offer no unitary approach as to which structure to use for obtaining the best results (Marquis and Straight, 1965; Correy and Starr, 1971; Rubinstein, Chakrabarti, O'Keefe, Souder and Young, 1976; Katz and Allen, 1985; Keller, 1986; Gobeli and Larson, 1987). For example, speed and flexibility are primary attributes of project teams involved in major technological breakthroughs with urgent time parameters demanded in first to market strategies. Also, working in project teams helps to create a sense of team identity and project ownership that can lead to very high levels of commitment. One interesting finding from the research was that project teams were more successful in completing complex projects than less complex projects.

2.7 Teams

One of the distinguishing features of successful companies often observed in the management literature is the extent people work together as a team. Margerison and McCann's (1990) studies of successful organisations point to teamwork and the skilled management of people as the key contributors for success. A number of well known organisations have a reputation for encouraging teamwork such as Shell, Hewlett Packard, 3M, Tektronix, IBM and, more recently, Japanese companies such as Sony, Hitachi, Nissan, NEC, Honda and Mitsubishi.

Innovative teams are generally relatively small in size, ranging from 2 to 12 persons and consist of specialists from a variety of disciplines and functions. According to Katzenbach and Smith, a team:

> 'is a small number of people with complementary skills who are committed to a common purpose, set of performance goals, and approach for which they hold themselves mutually accountable'
>
> Katzenbach and Smith (1991, p.112)

According to Katzenbach and Smith (1991) the main task of the team leader is to get the team to perform to the highest level and Margerison and McCann (1990) argue that team leaders should spend most of their time managing the group and have a good grasp of team management theory. Teamwork, they say, is practised every day in the boardroom, in government and in industry, but in most cases the players have little understanding of team dynamics and how to evaluate the team to the best advantage. Business plans, according to Tushman and Nadler (1986, p.84), may be evaluated by a board of directors made up of corporate executives who have an interest in the venture, but teams engaging in the innovation process are evaluated by other criteria than profit and return on investment. Their success is more likely to be measured in terms of growth in sales over a period of time or market share.

Teamwork is likely to be the key to effective working, particularly where multiple disciplines are required for projects. In high technology companies such as electronics and bio-engineering, for example, a wide range of interdisciplinary skills is required. No one person can usually be skilled in all disciplines and he/she must therefore rely on teamwork to address the day to day problems that arise. The effective team leaders are those who work through the team, with success being contingent upon the team working as a cohesive unit. One major British based, U.S. owned, pharmaceutical company visited by the researcher, stresses the importance of innovative teams as a means of achieving a significant increase in team productivity and in meeting deadlines for the introduction of a given new product to the market; regulatory restrictions notwithstanding.

Not all new products stem from in-house R&D. Companies such as Hoffman la Roche and Merck that are among the leaders in the field of pharmaceutical products often use the vehicle of collaboration through a third party to achieve some of their product breakthroughs. They invest many millions of dollars through research relationships with universities and clinical grants. In the scientific field companies, like the U.S. based TSI (Thermal Systems Inc, Minneapolis/Saint Paul) and the British based ICL, use grants to sustain expertise in academia to complement the work done in their own R&D departments. They seek a fair return on their investment and require a reasonable assurance from their R&D partners that a given innovative product will be developed on schedule, thus giving them a competitive edge. Interestingly it was Mansfield, Rapoport, Schnee, Wagner, and Hamburger (1981) that discovered that between the years of 1935 to 1962, half of all major

innovations in the pharmaceutical industry came from outside of the organisation that ultimately exploited their manufacture.

2.8 Summary of Chapter

New product development is usually the result of a competitive strategy and is a strategic response to the external business environment. New product introductions may be a success or they can fail and some failure must be anticipated. NPD often involves innovative design that stems from an awareness of customer needs and user demands and frequently has an Intrapreneur at the centre of activity. Organisational innovation concerns designing the appropriate degree of de-centralisation to manage the process of NPD in order to make the team leader as effective as possible. R&D needs to be managed effectively so that productivity and performance are maximised.

Chapter 3 Decentralisation and Autonomy

3.1 Introduction to Chapter

This chapter deals with the delegation of authority and divides autonomy into two areas of responsibility. It describes empowerment and autonomy and discusses the relationship between autonomy and control. Job autonomy and control studies are reviewed and related to the NPD team leader context.

3.2 Decentralisation

Decentralisation of authority has long been considered to be an important consideration in job design for the individual and group. Managerial decentralisation has become a feature of previously homogenous companies operating primarily in one sector and is an attempt to find more flexible, innovative ways of achieving entrepreneurship at lower levels of management (Colling and Ferner, 1992, p.209). Giving greater autonomy to the individual and group has a number of advantages. Given the uncertainties of creating and implementing an innovative product, companies pursuing a policy of multiple innovations find that decentralisation provides a context in which more ideas are generated than in a centralised one (Burns and Stalker, 1961; Thompson, 1961). Also, within a decentralised structure, managers enjoy greater autonomy and more control over resources, enabling them to initiate and test a greater number of creative new ideas.

3.3 Empowerment and Autonomy

Empowerment has become widely recognised within the organisational sciences (Harrison, 1983; Kanter, 1983; Bennis and Nanus, 1985; Burke, 1986; Neilsen, 1986; Block, 1987; House, 1988) but has, as yet *no agreed* on definition (Thomas and Velthouse, 1990, p.666). Shatzer and Schwartz (1991) refer to Peter Senge as saying that there are two levels of empowerment to be examined in an organisational setting, firstly, the dynamics between individuals in a relationship and secondly, the structures and systems in which people operate. The biggest barrier to empowerment, they suggest, is the emphasis society places on money, power, ego and control which interferes with the reciprocity of relationships and mutual learning.

Topaz (1990) defines empowerment as giving employees the maximum amount of power to do a job as they see fit. Ripley and Ripley (1992, p.21) regard empowerment in terms of 'placing the responsibility of decisions further and further within the organisation'. Empowerment means encouraging people to make decisions and initiate actions with less control and direction from their managers (Hand, 1993). Empowerment involves the creation of a corporate environment in which individuals at all levels are expected to exercise whatever power is necessary to remove barriers to better performance (Thomas, 1991). Finally, Conger and Kanungo (1988, p.475) define empowerment as 'increases in workers effort-performance expectancies'. These authors

recommended that empowerment be defined in terms of motivational processes in the worker in order that researchers studying the effects of empowerment may define more accurately what the effects of different interventions are.

3.4 Autonomy and Control

Recent literature reviews on the control construct in the workplace have linked job autonomy with perceived control (Spector, 1986; Wallston, Wallston, Smith and Dobbins, 1987; Feldman, 1989; Ganster and Fusiler, 1989) some of which deals with the tensions which arise in achieving the co-existence of autonomy and control. According to the English Dictionary autonomy is defined as: the power or right of self government. Autonomy for the individual and work groups received special prominence during the Second World War with armaments and aircraft companies such as Lockheed when Clarence L Johnson introduced the now (in)famous *Skunk Works*. Kelly Johnson, as he was affectionately known, organised the division in 1943 to design, build and prove the first tactical Jet fighter in the United States, the XP80. The plane was designed, built and flown 143 days after the project was started. In their book, a 'Passion for Excellence', Peters and Austin (1985) describe the methods used at Lockheed during 1943 (pp.194-196). H S Blackie Shanlian explains how his position was affected by the empowerment/autonomy given to him.

> 'Besides supervising my crew, I did all the planning, procuring, record keeping, liaison engineering and co-ordinating with the design engineers. In addition, I was timekeeper, safety man, security man and employment representative; and I loved every minute of it'
>
> (quoted in: Peters and Austin, 1985, p.195)

Autonomous work group studies continued after the war (Trist and Bamforth, 1951; Rice, 1958; Pearson, 1992). In the field of production and research and development it has been claimed that autonomy greatly facilitates improvement in work but the introduction of process controls, however, impacts on the individual or work group autonomy and raises the question of whether process autonomy is still feasible in today's work organisations. (Hackman and Oldham, 1976; Cummings, 1978; Klein, 1991).

In order to test the arguments about the forms autonomy and control can take, (including strategic and operational) it is necessary to operationalise the differing notions about autonomy which prevail in the literature. One definition of autonomy can be traced back to Hackman and Oldham who define it as:

> 'the degree to which the job provides substantial freedom, independence and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out'
>
> (Hackman and Oldham, 1980, p.79)

Feldman (1989) defines autonomy in Weberian terms as 'self directed behaviour within the general limits set by managerial control'. He argues that both individual autonomy and hierarchical control are always present in organisations and neither can exist without the other:

> 'Not only are autonomy and control needed in organisational innovation, but they cannot be understood separately, because autonomy is dependent both structurally and managerially on a context of control.'
>
> (Feldman, 1989, p.86)

Autonomy, he says, assumes autonomy or independence from something. Feldman tried to analyse the relationship between autonomy and control in a conceptual framework and applied it to managers and engineers in an electronics company as they tried to innovate. Feldman makes four general conclusions on autonomy and control:

'1. Autonomy and Innovation always depend on a context of control for their relevance to an organisation.
2. Under conditions in which innovation is required and autonomous behaviour is important, general management control is needed.
3. When control and autonomy are not in balance, a vicious circle can develop which is likely to undermine commitment to an organisation's goals.
4. Innovation in organisations requires participants to have a high developed sense of the legitimate possibilities of autonomy in organisation.'

(Feldman, 1989, p.83)

Garnsey and Wright (1990, p.280) argue that autonomy is a 'desirable end in stimulating the independence of thought essential for innovation, but without forms of accountability which provide feedback of the effects of past activity, autonomy entails isolation and ignorance'. In essence, they too argue for a balance between autonomy and control. Donaldson (1985, p.7) characterises autonomy in terms of entrepreneurial activity. He states that, 'one of the essential characteristics of entrepreneurship is autonomy, freedom to take decisions according to the individual's judgement in the light of market opportunities'. Klein (1991, p.24) says that because autonomy is critical, socio-technical work system designers have developed a methodology for analysing and breaking work processes into natural components which are then used in an effort to minimise requirements for external controls, thus providing the individual with as much 'independent discretion' as possible. She concludes that there exists new opportunity for participative decision making especially in collective task design but with less room for individual autonomy in task execution.

The interpretation of the R&D literature is that employees within the R&D function have high expectations for autonomy and control over their work and this is in common with other professionals (Bailyn, 1985; Raelin, 1989; Barczak and Wilemon, 1992; Bart, 1993). According to Barczak and Wilemon (1992), research on project teams indicates that technical professionals desire high degrees

of autonomy and control over their activities and that these individuals want to make their own decisions about their roles and responsibilities and how to solve specific problems (p.63). They believe that NPD team leaders also need autonomy to make important decisions about project focus and direction and to determine project members' responsibilities. They further hypothesise that the more successful new product development team leaders will perceive themselves as possessing more autonomy than their less successful colleagues.

Bart (1993) conducted some empirical research into formal and informal control practices that business unit managers use to control various new product situations. Nowhere, he says, is the problem of managing new products more acutely expressed than in the area of organisational control (p.187). He believes that it is a commonly held view that the tight organisational control practices of large modern corporations are among the primary forces which stifle and impede innovation. It is therefore essential that management find ways to reduce bureaucracy in the organisation to improve the frequency and speed of new product output. Bart's research was conducted in order to better understand the control practices that business unit managers use to influence the outcome of NPD projects. He believes that too much attention has been paid to tight control practices and some of the more important factors in enhancing new product output that he says have been overlooked are:

- the need for balance in deploying a set of loose and tight controls
- the importance of formal controls
- the role of informal control methods and,
- the relationships among managerial R&D project control, new product strategy and new product output

Bart (1993, p.187) states that 'control refers to that set of procedures, systems and actions that managers use to monitor, evaluate, influence and/or define what their subordinates are doing'. Bart's empirical investigation into control reports five findings on effectively controlling new product development in R&D:

1. Business unit managers control new product R&D projects differently from established products
2. The method of controlling new product R&D projects varies with the product strategy of the project
3. The control approach a business unit manager adopts is closely related to new product R&D output
4. Formal controls need to be reduced to enhance new product output, but some minimum level is always required, which agrees with the statement by Feldman, 1989.
5. Business unit managers compensate reduced formal control with high amounts of informal control

Bart concludes by saying that business unit managers need to examine their approach to controlling R&D projects since it is likely to affect new product output.

Studies of control in the workplace have linked job autonomy with perceived control. Spector's (1986) meta analysis estimated the degree and direction of the relationship between perceived control and nineteen employee outcome variables. The results of the meta analysis showed that high levels of perceived control were associated with high levels of job satisfaction, commitment, involvement, performance and motivation, and low levels were associated with physical symptoms, emotional distress, role stress, absenteeism, and turnover.

In two separate longitudinal field studies by Greenberger, Strasser, Cummings and Dunham (1989) into the relationship between personal control and job satisfaction and performance, they hypothesised that having personal control significantly enhanced job satisfaction and performance. The authors (1989, p.31) define personal control as 'an individual's beliefs, at a given point in time, in his or her ability to effect a change in a desired direction on the environment'. A perceived lack of personal control can have a demotivating effect on R&D specialists, for example, Garnsey and Wright (1990) found their respondents reported high levels of frustration and job dissatisfaction resulting from the shelving of potentially promising projects. Greenberger et al (1989) argue that individuals generally desire more control than they possess and that personal control is one component of intrinsic motivation. Their longitudinal field studies confirmed three hypotheses supporting reciprocal relationships exist between control possessed and performance, and between control possessed and job satisfaction. The three confirmed hypotheses were:

- on average, organisation members will desire more control than they possess.
- the greater the amount of control possessed, the higher the performance.
- the more control possessed, the greater the job satisfaction.

The importance of control, performance and job satisfaction for the individual has implications for the organisation. Greenberger et al's study shows that the mean scores for control desired are greater than the mean scores for control possessed. When control is perceived to be lessened, individuals react less to stress and are likely to display withdrawal symptoms and performance is likely to diminish. 'Control possessed' shows that the higher the control possessed, the greater the individual's performance and their results demonstrate that control possessed is found to improve significantly in overall job satisfaction. The authors believe that there is evidence that control possessed may be an apparent cause and outcome of both job satisfaction and job performance. However, without experimental evidence, this is only speculative at this juncture.

Whittington (1990) regards the management of expertise as being about managerial assaults on the autonomy of R&D functions. Whittington (1991) believes that industrial R&D has undergone a restructuring following the immediate post-war period. The centralised R&D laboratory characteristic of large, diversified corporations has been challenged by a 'new fragmented model', more responsive to customer demands (p.43). Whittington's (1991) study of six in-house and eight industrial R&D organisations, analysed them for three types of R&D control strategy; hierarchical control, market control and professional control. The hierarchical control strategy is where the exercise of authority through a hierarchical structure limits channels of behaviour (Weber, 1946). A number of researchers have argued that hierarchical control can stimulate innovation, albeit most often decentralised to the operational divisions and under direct authority of local divisional managers. In a market control strategy, control is exercised through market mechanisms rather than directly through hierarchy where in-house R&D has to pay for itself through the introduction of new product designs needed by the market place. Whittington concludes that market control strategies enjoy a marked improvement in productivity. The professional control strategy he describes as typical of in-house centralised R&D units of the early post war period and the industry research associations prior to 1971. Whittington argues that this strategy corresponds to the 'clan' form of organisation proposed by Ouchi (1981) in which authority is legitimated and members are united by a strong set of common values and beliefs.

Within the context of market control, Dougherty (1992) proposes four classes of market technology knowledge (visceralization, feasibility, fit with firm, emerging trends) and offers three new organising principles for the practice of product innovation:

'1. a redefinition of individuals' roles and responsibilities in terms of a realistic, yet holistic sense of tasks.
2. a reconception of work as a social and collaborative process.
3. a revision of strategy as an ongoing process which specifies clear, succinct goals, articulates them across the organisation, and revises them.'

(Dougherty, 1992, p.87)

Dougherty also reports that successful innovators in her research felt committed to and responsible for the entire product effort and did not execute only segmented portions of the overall tasks.

At the corporate level, strategic control may be defined as the successful implementation of strategic plans. Strategic control of a division, for example:

> 'defines the criteria of good strategic performance, motivates managers to deliver against them, permits early identification of strategies that are going off track and, where necessary, triggers a search for fresh strategies or better means of implementation'

(Goold, 1991 p.70)

The strategic control of divisional managers thus is concerned with both the feedback to managers on how well they have performed and the preventative measures that can be taken when things go wrong. The extent that individuals are able to control the pace of work or procedures involved is frequently determined by the technology (Davis and Taylor, 1975 and Slocum and Sims, 1980). Nevertheless, on a daily basis there is often some latitude for individuals to influence the methods of production processes and development work (Hackman and Oldham, 1980, p.79).

Project team leaders too have strategic controls in order to ensure that plans are on track and that the necessary action is being taken to rectify any problems which would result in delays to the project's completion. Goold (1991) distinguishes in a corporate sense budgetary control from strategic control; budget control stresses profit and other financial objectives such as cash flow, but frequently, budgetary control has more to do with cost over-runs and staying within budget constraints. It could be considered to be a strategic variable by regarding the role of the team leader as including a responsible attitude towards capital resources. As with Goold's model project team leaders will generally have their achievements monitored against an agreed set of objectives. Whilst there may be an analogous association between Goold's interpretation of strategic control in a decentralised corporate setting and the strategic control of a project team leader, the project team leader is not usually extensively involved with company board level issues such as corporate profitability and financial objectives. In a similar vein, in my model of operational control, the project team leader is held accountable for the day to day operations and will, by virtue of the autonomy invested in him/her, be accountable to a senior manager.

3.5 Measures of Autonomy

Measures of work autonomy have been developed, particularly within the framework of job design, outside the R&D management context. Scales have been developed to measure dimensions or facets of autonomy (Breaugh, 1985). Breaugh identified three scales to define the construct of autonomy. These are:

i) Work Method Autonomy, the degree of choice/discretion individuals have with regard to the procedures or methods they adopt in carrying out their function.

ii) Work Scheduling Autonomy, the extent to which workers feel they have control over the scheduling of work.

iii) Work Criterion Autonomy, the degree to which workers have the ability to modify or select the criteria used for evaluating their own performance.

This thesis uses Bailyn's distinction between strategic and operational autonomy. She defines strategic autonomy in an R&D setting as the 'freedom to set one's own research agenda' and operational autonomy may be described as 'the freedom, once a problem has been set, to attack it by

means determined by oneself, within given resource constraints' (Bailyn, 1985, p.134). Bailyn refers to intensive studies both in the U.S.A. and Britain and suggests there is an over-simplification that hides the real issues facing technical employees in industrial R&D. There needs to be a differentiated view of what autonomy means in an industrial setting as well as a better appreciation of the orientations of people who populate the professional ranks in R&D. By understanding employee orientations toward 'strategic' and 'operational' autonomy management is better able to help the individual understand the contribution *he* or *she* is expected to make to the project or the organisation. The formal observation of an individual's performance at work is, generally, through employee assessment or appraisal and is, in many companies, frequently coupled with a continuous development programme. In a chapter on "Employee Appraisal", Randell (1989) postulates that, 'the overriding purpose of employee appraisal is the improvement of the performance of people in their jobs' (p.156) and, in a related subject, Wood, Barrington and Johnson (1988), argue that 'an important part of the training process for continuous development is the dynamic approach whereby employee appraisal is informed (ideally) by an organisationally driven overview of strategy and objectives, leading to improved, individual, performance plans' (p.14).

Bailyn produced a model of the relationship between strategic and operational autonomy, figure 3.

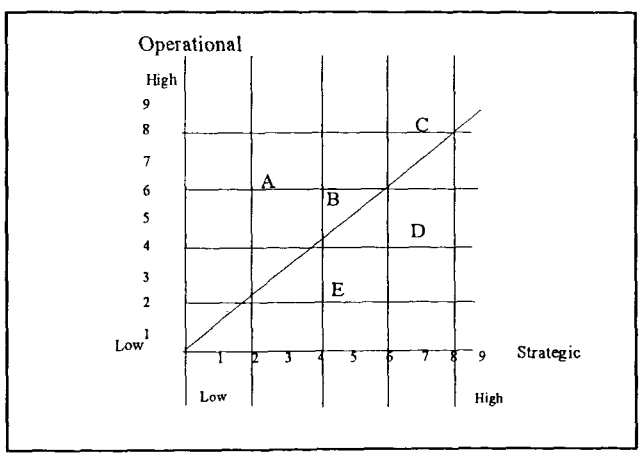


Figure 3: Autonomy in the R&D Lab. Strategic Autonomy: Setting Goals, Defining Problems. Operational Autonomy: Controlling Means, Modes of Implementation, Solution Procedures.

Bailyn used this graph as a basis for testing some ideas using data from eighteen professionals in the central research laboratory of a large consumer products company (p.135). She asked the respondents, taken from the science and engineering fields, where they would place themselves on the grid, what their position had been at the time of entry and where they considered would be the ideal position for professionals and managers in the R&D laboratory. Arbitrary letters A-E have been inserted into the graph to indicate possible positions chosen.

Bailyn argues that the ideal position for technical R&D employees is to the left of the 45 degree diagonal, with operational autonomy equal to, or greater than, strategic autonomy. But she also

postulates that the position of the R&D team manager is to the right of the diagonal with strategic autonomy having a greater weighting than operational autonomy; position 'D' for example. According to Bailyn (1985) R&D managers (and thus in an industrial R&D setting, team leaders), frequently occupy a H- L position on the graph where H = high on strategic autonomy and L = low on operational autonomy. Team leaders are best placed in this position if they are to be good administrators and managers of the development lab. However, this position is not ideal if they are seeking to enhance their technical career prospects rather than their managerial career paths.

As discussed in chapter 1.3, there has been some disagreement about whether variables, such as autonomy, should be assessed via employee self reports, or by trained job analysts (Breaugh, 1989, p.1051). There are some obvious drawbacks to self reports, for example the respondents might:

1. rate their position more favourably than is actually the case.
2. rate themselves differently if they think that career advancement may be involved.
3. have a different set of judgement criteria than the researcher.
4. may lack the expertise to make an accurate measurement.
5. find it difficult, if not impossible, to understand the meaning of the questions.

As mentioned in chapter 1.3 Raelin (1989), in an article on autonomy, proposes that it is best considered as comprising of three components: (i) strategic (ii) administrative (iii) operational. His concept of strategic autonomy involves the freedom to select goals and policies for the corporation. Administrative autonomy is a sector overlapping strategic and operational autonomy, whilst his third component, operational autonomy, is very similar to that proposed by Bailyn in that it involves having the freedom, once the goal or problem has been set, to attack it by means determined by oneself, but within administrative and strategic constraints. Raelin says that strategic autonomy is placed into the hands of executives and that operational autonomy is placed in the hands of the 'professionals'. Administrative autonomy, he proposes, lies in the hands of managers. This description of the distribution of autonomy is based on his own personal observations and experience and, he admits, requires empirical validation.

In the context of managing human resources, Boreham (1992) conducted an international study of the organisation of work in advanced industrial societies in which he considered autonomy. This work also relies on self reports to construct autonomy by producing an additive scale of responses of individuals from the following items:

'1. In your job, are you required to design important aspects of your own work and to put your ideas into practice? Or aren't you required to do these things?
2. Can you decide when to come to work and when to leave work?
3. Can you decide to take a day off without losing pay or having to make it up in some way?
4. Can you considerably slow down your pace of work for a day when you want to?

5. Can you decide on your own to introduce a new task or work assignment that you will do on your job?'

(Boreham, 1992, p.102)

In conclusion he finds that flexible production techniques and organisational forms do not appear to have usurped the Fordist organisation of the labour process, and there is little evidence in the data presented to suggest that participative organisational practices have made any significant incursion into traditional managerial prerogatives in the workplace in any of the countries studied.

Brookes (1992) adopts a more managerial perspective observing that as more organisations move toward self-managed and cross-functional teams and semi-autonomous work groups, the issue of accountability may not be adequately managed. Brookes quotes the management theorist Elliott Jaques asserting that if a team leader is to be held accountable for the work of the team, then the team leader must have:

'1. the right to veto any member of the team.
2. the right to decide tasks and assign work tasks and deadlines.
3. the right to make final judgement on performance review and raises.
4. the right to initiate, with due process, the removal of employees from the unit.'

(Brookes, 1992, p.14)

The thesis considers control as a managerial concept involving strategic and operational aspects. Tymon and Lovelace's (1986) survey of the R&D literature 1960-1983 led them to hypothesise that organisational history, profitability, structure, task environment, type of research conducted, and hierarchical level of control are important determinants of the type of control employed. The authors classify variables in the R&D process into three dimensions of *focus* (project, related projects, programmes), *technical effort* (project milestones, programme goals, organisational agenda) and *financial orientation* (expense, capital). They then list a set of hypotheses for future research systematically presenting the determinant under each of the three dimensions. For hierarchical level of control, for example, they hypothesise for commercial R&D organisations where control is exercised at the higher levels of the organisation, the variables will have greater content emphasis on corporate goals and a financial orientation toward capital. Alternatively, they hypothesise, when control is exercised at the lower levels there will be greater content emphasis on projects, greater technical emphasis on milestones and more financial emphasis on expenditure.

Boreham (1992) operationalises the concept of control into three categories that he believes encompasses the different practices of discretion at work. First is that individuals are constrained within the parameters of their own job; a measure of control indicating the autonomy available to individual employees. Second is the control of the methods of production and the authority available for a particular level of decision making. The third category involves the economic level of decision making.

3.6 Task Responsibility Variables

Given the arguments of Bailyn, Raelin, Brookes and Tymon and Lovelace discussed in section 3.5 it is possible to define some common project tasks into 'strategic' and 'operational' variables. This thesis addresses autonomy in NPD in both the pilot stage and main study by dividing it into thirteen project-related task variables; six strategic and seven operational. In this study *strategic* and *operational* task variables represent a mixture of the terms taken from the literature review and the empirical study and which will now be outlined and discussed:

Strategic Variables

- Team Selection
- Team De-Selection
- Budget Setting
- Budget Spending
- Project Selection Criteria
- Rewarding Team Success

Operational Variables

- Project Design
- Project Planning
- Project Scheduling
- Project Implementation
- Project Reviews
- Project Evaluation
- Project Deadlines

Table 1 below indicates the literature source and the defined type of autonomy.

Author	'Strategic' Autonomy	'Operational' Autonomy
Raelin (1989), Brookes (1992)	(a) Team Selection	
Raelin (1989), Brookes (1992)	(b) Team De-Selection	
Tymon and Lovelace (1986)	(c) Budget Setting	
Tymon and Lovelace (1986)	(d) Budget Spending	
Bailyn (1985)	(e) Project Selection Criteria	
Brookes (1992)	(m) Rewarding Team Success	
Tymon and Lovelace (1986)		(f) Project Design
Tymon and Lovelace (1986)		(g) Project Planning
Tymon and Lovelace (1986)		(h) Project Scheduling
Brookes (1992)		(i) Project Implementation
Raelin (1989), Tymon and Lovelace (1986)		(j) Project Reviews
Raelin (1989), Tymon and Lovelace (1986)		(k) Project Evaluation
Tymon and Lovelace (1986)		(l) Project Deadlines

Table 1: Establishing the link between task variables and the literature

The categories of 'strategic' and 'operational' autonomy were developed from Bailyn, Raelin, Brookes and Tymon and Lovelace's work and, by implication, from Davis and Taylor, 1975 and Slocum and

Sims, 1980, Hackman and Oldham, 1980, Borcham, 1992. Having established the task variables they will be further linked to four stakeholders in a model in chapter five.

Given the discussion in this section about the decentralisation of authority, the measures of autonomy and the managerial concept of 'strategic' and 'operational' autonomy, it seems clear that the research needed to be structured in such a way that the 'common' project tasks presented in table 1 and used to describe autonomy, must first be validated and then tested. Such research involves two methodology 'paradigms' known as phenomenology and positivism, which will be discussed in the next chapter. Also, since there is a paucity of literature on NPD, in particular that relating to team leader autonomy, and that the concept of autonomy must first be validated, it was decided not to propose any hypotheses in the orthodox sense in this study.

3.7 Summary of Chapter

This review has analysed the type of autonomy granted to team leaders including how task variables may be defined and considered how to construct a team leader autonomy map as was originally proposed by Bailyn (1985).

Typically companies engaged in NPD have organisational structures that tend to be flat, decentralised and informally complex. The tendency today is to encourage a degree of autonomy which has been described in the autonomy studies as the discretion exercised in how the pace of work and work methods are designed and implemented. With a decentralised structure managers enjoy greater autonomy and more control over resources, enabling them to initiate and test a greater number of creative new ideas. Empowerment places greater responsibility on employees than before for identifying and solving problems and has been an important management initiative for achieving quality improvement. Autonomy may be separated into two distinct areas, strategic and operational. As a contributing factor towards business success and assisting in the continuous development of employees, autonomy has been argued to be an organisational means of achieving innovative team leadership below top management levels.

Chapter 4 Pilot Study Interviews: Method and Findings

4.1 Introduction to Chapter

This chapter will look briefly at the two research methodologies used in this work, 'phenomenology' and 'positivism', describing the former. The latter will be examined later in chapter six. One of the original research objectives was to investigate the intrapreneur and/or team leader against a background of new product development in the business environment, to examine the mechanisms by which authority is delegated and to assess the degree of autonomy present. The emphasis was later changed to concentrate on the team leader for reasons given at the end of this chapter. What now follows is a report on the research carried out up to the point of modifying the objective.

4.2 Research Philosophies and Methods

Carrying out research involves three interrelated aspects. First, one needs to think about the kind of knowledge one is attempting to produce and concerns epistemology. 'Epistemology', according to Chambers Dictionary, is *the theory of knowledge*, thus epistemology is concerned with what does and does not count as knowledge. Second, is a need to look at the theoretical issues surrounding a particular area of enquiry. Third, one needs to consider which technique is appropriate for data collection. This thesis will restrict itself to two methodological approaches to social research, 'Phenomenology and Positivism' (Harvey and MacDonald, 1993, p.58). Positivisim will be discussed in chapter six. Phenomenology starts from the idea that reality is socially constructed rather than objectively determined, thus researchers do not gather facts and measure the frequency of occurrences in the data but rather try to understand the different constructions and meanings that people place upon their experience. A simple example of this could be the way in which a researcher might study one aspect of the subject of this thesis, team leader autonomy. The social constructionist is likely to be interested in 'people's beliefs and interpretation of the world [which] ...enable(s) them to give meaning to what they perceive' (Buttery and Buttery, 1991, p.27).

Qualitative research is used in this thesis as a means of familiarisation before the serious sampling and measurement begins. Not surprisingly, this and other qualitative research is used to describe and add meaning to the social world as prescribed by the phenomenology paradigm. The first part of this research is qualitative and uses depth interviews which is the most fundamental of all qualitative techniques. The objective of using the interview technique in this case is to understand how individuals construct the meaning and significance of their situations in respect of their personal experience, and how they interface with project team leaders in NPD. The philosophical principle underlying this approach is that by presenting a faithful account, the researcher's biases will not intrude upon the data. However, this research is interested in going beyond a simple presentation of data and will analyse the information gathered by means of content analysis and grounded theory. Grounded theory is a means of building theory and the development of theoretically informed

interpretation is a most powerful means to bring the reality of phenomena to light. Data collection, analysis and theory stand in reciprocal relationship with each other. Theory is derived by determining what is relevant to a given area and allowing it to emerge.

> 'Building the theory, by its very nature, implies interpreting data, for the data must be conceptualised and the concepts related to form a theoretical rendition (a reality that cannot actually be known, but is always interpreted).'
>
> Strauss and Corbin (1990, p.22)

4.3 Pilot Research Method: Interviews

In this section we report the research method of the pilot research interviews which explore the subjects of intrapreneurs, innovation, autonomy and organisational structure in the intrapreneurial process. We then discuss the methods used for acquiring the preliminary data and review the initial findings. The research questions used in the semi-structured interviews are discussed. The approach to qualitative and quantitative data collection methods is examined and justified.

The preliminary qualitative research was by means of semi-structured but flexible interviews so that a broad exploration of views on the research questions could be sought. On the basis of the pilot research interviews, the researcher was able to formulate a clearer idea on the issues and devise a set of structured questions for a postal questionnaire survey in order to better define the arguments for the main research study. The interviewees were taken from the field of Software Development, Computer Manufacture, Pharmaceutical Producers, Vending Machines and Management Consultants.

For the purposes of the initial study companies visited were of a size greater than $50m per year turnover and where new product development is important to their long-term growth. Later, for the purposes of the second part of the study, the company size was lowered in order to increase the sample frame. There was no fixed size of trial sample and the actual number of interviews conducted was based on the availability and willingness of managers to co-operate in the work. According to Harvey and MacDonald (1993, p.125), 'a minimum of 5 interviews' should be held. In the field study 15 respondents from 8 companies were interviewed and the results were used together with relevant literature to contribute to the formulation of the pilot questionnaire.

The original objectives of the pilot research interviews were:

(i) To enquire into the mechanics by which intrapreneurs (or team leaders) are selected for projects and the criteria by which he/she manages a team.

(ii) To investigate the level of decision making and the degree of autonomy given to the intrapreneur/team leader.

(iii) To look at who is responsible for setting and monitoring objectives and what organisational structures have been established in companies for facilitating intrapreneurial performance.

The names of potential respondents were obtained by using known contacts within companies as a means of gaining an introduction to the person responsible for, or associated with, new product development. In each case once a person in the company responsible for new product development had been identified, he/she was approached by telephone to ask whether they would participate in the preliminary phase of the research. The objectives of the research were given and appointments to conduct interviews were made.

Below is a list of 15 people interviewed (7 in the U.S.A. and 8 in the U.K.), the position they occupy in the company, and the type of company they come from. All interviews except for the Ion Implantation Devices and Components Manufacturing companies were tape recorded and transcribed.

	Company Type	**Position**	**Country**
1)	Software Development	Vice President, Technology	USA
		Vice President, Product Marketing	USA
		Vice President, Finance	USA
		Product Manager	USA
		Manager, Technology	USA
		Manager, Product Marketing	USA
2)	Pharmaceuticals	Project Manager	UK
3)	Computers	Director of R&D	UK
		Project Manager (Team Leader)	UK
		Product Dev. Manager (Intrapreneur)	UK
		Director of Prod. Development	UK
4)	Management Consultant	Director of Intrapreneurship Programme	UK
5)	Vending Machines	Director of Personnel	UK
6)	Ion Implantation Devices	Director of Production	USA
7)	Components Manufacturer	VP Technology	UK

The first part of the research is qualitative and was based on the model of grounded theory in order to analyse and better understand the data. A grounded theory is one that is inductively derived from the study of the phenomenon it represents and needs to meet four central criteria for judging the applicability of theory to a phenomenon: fit, understanding, generality and control (Strauss and Corbin, 1990, p.23), a full discussion of which follows in the next chapter. In order to extract meaningful data from the pilot interviews to achieve these criteria we need a series of research

questions that will give us the flexibility and freedom to explore phenomena in depth. Questions need to be initially broad in scope and then narrowed down as the research progresses. Research questions in a grounded theory study are statements that identify phenomena. They indicate what one wishes to focus on and what one wishes to know about the subject. What now follows is a discussion on how a series of interview questions (**Q**) were first developed.

4.4 Interview Schedule

Q1 *By what criteria are intrapreneurs selected?*

The existing literature is uninformative on how intrapreneurs are selected. This question has important implications for the firm. Are they selected by some process whereby management recognises a given talent, or are they more self selecting along the lines of the intrapreneur first postulated by Pinchot (1985) or appointed to the role as suggested by Riley, 1987 and Burgelman, 1984, or created out of 'skunk works' as proposed by Single and Spurgeon (1996)?

Q2 *What level of decision making is needed for the intrapreneur (corporate entrepreneur) to enhance creativity and productivity?*

The purpose of this question was to better understand effective self-management as a means of enhancing productivity. The literature suggests, in general, that intrapreneurs need substantial autonomy if they are to manage NPD effectively (Pinchot, 1985; Oliver, Pass, Taylor, and Taylor 1991; Rigg, 1992; Shipper and Manz, 1992; Sims and Lorenzi, 1992). By conducting empirical research it was hoped to find out how important practitioners felt the relationship is between the level and nature of autonomy given to individuals and the ability of intrapreneurs to perform their function effectively.

Q3 *What are the critical aspects of reporting relationships for the team which enhance creativity and productivity?*

This question addresses the problem of how well teams perform in relation to their level of reporting. The literature suggests that teams perform best when they are self managing and have a high degree of input to the objectives set. It is also suggested that the level of empowerment is critical to team performance (Manz and Sims, 1989; Mckee, 1992; Rigg, 1992) and it is said that self directed teams are among the types of teams that business owners and consultants believe can lead to quality improvements.

Q4 *How are the objectives identified, defined, turned into tasks and monitored or evaluated for the intrapreneur and team?*

McGregor (1960, p.241) points out that 'many significant objectives and measures of performance can be developed for the group which cannot be applied to the individual'. Under the right conditions there are positive advantages to be achieved through engaging in group effort. Reich (1987) says that

collective entrepreneurship entails working closely together among people at all stages of the process. By asking a series of linked questions it was hoped to identify the elements concerning whether agreed objectives significantly enhanced group performance.

Q5 *What are the facilitating organisational structures for best performance? How are these structures customised to suit the: individual, team, and organisation?*

Many innovative organisational structures are separate from the core organisation of the firm. Innovative teams are frequently relatively small in size ranging from 2 to 12 persons or so and consist of specialists from a variety of disciplines and functions. Katzenbach and Smith (1991, p.112) define these teams as characterized by common goals, commitment and shared accountability.

Rothwell (1974) identifies the increasing degree of concentration in industry, in particular the Science based industries, where the need for innovation is greatest. He believes that there are several novel 'organisational forms' which have been experimented with in industry for the express purpose of creating an environment conducive to intrapreneurship.

Q6 *Any other opportunities and general issues concerning the management of innovation*

This research question was used to explicitly identify other issues not anticipated in the research literature reviewed nor considered by the researcher.

Each individual was asked to relate his/her work experience in terms of the basic research questions and to give examples, where possible, about the environment needed to create, or stimulate the innovative process. They were informed that they themselves need not necessarily be the creative person, so long as they related their experience in the process of innovation as accurately as possible. The interviewees were asked to recount any events which might be of interest that stood out in their mind, anything about others in the team or persons involved which had a part to play in the successful innovation process.

The interviewees were also asked for their opinions about events which may have led to a failed innovation and why this had happened. It was felt that by using this critical incident technique it would possibly avoid personal views than if they had simply been asked what was thought important for supporting or undermining the innovative process.

4.5 Interviewing Techniques

Interviewing has a number of advantages, particularly for a project of this nature. The main advantages are:

i) Direct one-to-one contact with decision makers.

ii) Open channels of communication with the interviewee after the initial contact.

iii) The possibility of making a better value judgement of qualitative data.

iv) Discussion of management and intrapreneur perspectives at length.

Care was taken to ensure that there was effective communication between the interviewer and interviewee. Questioning techniques must encourage the respondents to communicate their underlying attitudes, beliefs and values.

Hoinville Jowell and Associates in their book, *Survey Research Practice*, list four ways that frank discussion can be impeded:

> *'By attempts at rationalisation:* Respondents will often try to put forward only logical reasons for their behaviour, ignoring their emotional feelings and evaluations based on attitudes and beliefs.
> *By lack of awareness*: Most respondents are not accustomed to putting their feelings into words.
> *By fear of being shown up*: Respondents for example, will often avoid describing aspects of their own behaviour or attitudes that are inconsistent with their self image.
> *By over politeness*: Respondents may be shy or over anxious to impress the interviewer; they may feel that particular views are expected or desired and tailor their answers accordingly.'
>
> (Hoinville, Jowell and Associates, 1978, p.12)

The interviews were semi-structured conversations between the interviewer and the interviewee for the purpose of acquiring first hand information about the 'research questions' (Q) listed in Q1 to Q6. Although it might seem a perfectly reasonable method of eliciting information from respondents, the successful interview involves considerable social skill, careful questioning and the establishment of trust between interviewer and interviewee. Moser and Kalton (1989) refer to three broad concepts as necessary conditions for conducting a successful interview (p.271). The same criteria apply for acquiring good quality data via a questionnaire. The first is 'accessibility' of the required information to the respondent. There is no point in trying to obtain information from a respondent if he/she does not have access to the information the researcher is seeking. There are several reasons why this might be the case ranging from simply having forgotten over time to not being the right person to ask in the first place. It is thus extremely important to assure oneself of accessibility before choosing interviewees. Being aware of this particular limitation the interviewer made an effort to screen the potential respondents before the interviews and thus minimise this problem. The interviewer sought

information about the company background and position of the respondents before requesting the interview.

Secondly, the interviewee should be 'cognisant' of what is required. This problem was overcome by partly informing the interviewee about how the interview would be conducted and what role the respondent would play. The condition was further met by explaining to interviewees that if information was felt to be incomplete further clarification of questions would be sought during the interview. The third condition required for a successful interview is that of 'motivation' on the part of the respondent to both participate and answer questions as accurately as possible. This includes the initial decision on the part of the respondent to co-operate and a motivation to supply accurate answers, although it is often hard to judge whether the answers obtained do not contain distortions. Without such motivation it is impractical to proceed with the interview. Moser and Kalton propose that it is 'the interviewer's job to try and reduce the effect of factors tending to decrease the level of motivation and to build up the effect of those tending to increase it' (p.271). They add further points to the list of negatives previously stated by Hoinville, Jowell and Associates (1978, p.12), a desire to get on with other activities, dislike of the interview content and suspicions about the interviewer. Positive aspects to build up might be: curiosity, a feeling of duty, keenness to help the interviewer, an interest in the subject and a liking for the interviewer.

The behaviour of the interviewer, both verbal and non-verbal, is crucial to the success of the research interview. The respondents were made aware that the findings of the final report would not be based on their information alone and that it would reflect the views of a large cross section of industries. Indeed, a number of respondents only gave their agreement to participate in the research programme on the basis that the findings would contain information from a good cross section.

Using a tape recorder to gather data was beneficial for it saved extensive note-taking during the interviews and did not detract from the flow of a discussion. If only notes had been taken during the interview it would almost certainly have interrupted the train of thought of the respondent. Having the use of a tape recorder meant that the interviewer was able to listen attentively to what was said rather than losing some of the points by having to write things down. The disadvantage of using a tape recorder to gather information was that, in most cases, the respondent could, and did, wander from the subject, making it time consuming to transcribe. However, the brief notes taken at the time were helpful in identifying and clarifying the main points of the interview.

4.6 Pilot Research Interview Results

The pilot research provided insight into the practices of new product development in companies and will now be reported. One of the unplanned findings of this study revealed that intrapreneurs (at least in the U.K.) appeared to be unknown and management in the companies where the preliminary

research was carried out had little familiarity or understanding of this term. Their perception of the intrapreneur was more akin to what one would term 'project team leader' or simply 'team leader', with no distinction being made between either term. For this reason the subsequent research confined itself into looking at the degree of autonomy given to (project) team leaders in NPD companies. The findings from the pilot interviews are given below:-

Q1 *By what criteria are intrapreneurs selected?*

Top management has a degree of control of team leaders primarily through the selection process with senior management having main responsibility for selecting team leaders. Alternatives, such as self-selection and steering committees are used comparatively infrequently. On average the chief criteria by which respondent companies choose the intrapreneur/team leader are based on the individual's technical expertise and a track record of how well he/she can manage a group of individuals. Intrapreneurs/team leaders must be managers possessing general communication skills along with technical competence and organisational knowledge. The management of technical expertise is about organisational tasks and the ability to handle day to day routines. Their long term development comes through the experience they acquire in their job, moving around the organisation on projects and by being given training in management skills.

This type of management is quite common in medium to large sized companies such as the large electronics manufacturer Hewlett Packard, where employees at various levels in the company are put through an ongoing management development programme soon after they join the company. The aim is to provide the necessary range of management training from a very early stage of employment. It would not be unusual to find in this company, for example, the 'customer service manager' of a particular division becoming the head of operations in Europe. The individual would, of course, have filled several positions of authority before being given this opportunity.

40% of those interviewed thought that the intrapreneur/team leader must have management potential whilst approximately the same proportion of the interviewees felt that commitment to the job and communication skills were more important attributes. The commitment of the intrapreneur/team leader to any given project is critical to the outcome.

Only approximately 25% of those questioned stated that self-selection was more often the norm. One respondent at a major British based, U.S. owned, pharmaceutical company site visited by the researcher stressed the importance of self-selection as a means of achieving a significant increase in team productivity and in meeting deadlines for the introduction of a given new product to the market place.

Q2 *What level of decision making is needed for the intrapreneur (corporate entrepreneur) to enhance creativity and productivity?*

In addressing the question concerning the degree of decision making available to team leaders/intrapreneurs it would appear this has important implications for the firm in terms of the project and team management.

In the pilot interviews the level of the decision making authority granted to the individual encountered varied greatly. Typically, the team leaders interviewed expressed surprise at the lack of authority they had in making managerial decisions. Whilst some said they had an input in the team selection process none said that they were involved in decisions related to budgeting or rewarding team success. This result drew attention to the need to enquire more into the question of team related issues.

Q3 *What are the critical aspects of reporting relationships for the team which enhance creativity and productivity?*

The literature suggests that teams perform best when they are self managing and have a high degree of input to the objectives set and that the level of empowerment is critical to team performance.
Thirteen respondents, or 87%, had clearly defined attitudes and perceptions about team selection and team de-selection. The team typically reports to the team leader on a day to day basis but have their objectives set by management. In general, there was no hard evidence found in the interviews to suggest a link between the reporting relationship for the team and creativity and there was only anecdotal evidence that teams perform better when they are self-managing.

Q4 *How are the objectives identified, defined, turned into tasks and monitored or evaluated for the intrapreneur and team?*

Another approach to the challenge of innovation is to prepare for organisational change in which employees manage themselves. The literature has said that teams in which objectives are identified and agreed collectively have become an important factor in the competition between modern corporations. The interview data appears to indicate that more than 40% of teams were found to be self managing and needed very little help from team leaders in order to fulfil their tasks. However, approximately 33% of the teams were managed directly by a line manager or equivalent through the team leader. This form of project team falls into the category of a matrix which is believed to be less effective where complex projects are concerned. We discuss this more in detail in question 6. In general, objectives were set by management and both the team leader and team had only a minor say in what was to be achieved. Around 10% of those asked had a major input in setting objectives, but the vast majority had objectives identified, defined and set by management.

Q5 *What are the facilitating organisational structures for best performance? How are these structures customised to suit the: individual, team, and organisation?*

Each team leader or manager has his own methods for making the team successful, but the ultimate objective is to achieve a winning combination where individuals work together in order to meet the task objectives. The innovating organisation also needs to attract, develop and retain people to manage the idea development process. One of the key skills that is needed is managing and supervising ideas people. Typically, the kind of person that is an idea generator and champion does not always accommodate well to supervision. Identifying the elements about objectives and their significance for group performance was dealt with by the respondents quite uniformly. 33% of the respondents said that they operated with a team matrix, by which they meant that functional specialists are drawn from disciplines as required. The rest (67%) said that their employees worked in project teams and were managed by a team leader. In most cases teams did not meet to specifically agree and set performance objectives.

Q6 *Any other opportunities and general issues concerning the management of innovation (e.g. performance measures, reward systems etc.)*

The pilot interview research also looked at the question of facilitating organisational structures to see if these affected team performance, and any other opportunities and general issues concerning the management of innovation (e.g. performance measures, reward systems). From the literature it seems that, typically, companies engaged in innovation have organisational structures for this activity that tend to be flat and decentralised, informal and with high levels of complexity. Of those interviewed 33% said that they worked in a form of matrix structure which was set up to facilitate performance. However they did not find the matrix structure was effective since there were difficulties in the reporting relationship between team members and the discipline manager. This led to a conflict of interest between the line manager of the discipline to which the team leader officially belongs and the project or team leader. As a rule the majority of individuals operate as members of a team and rotate within the organisation after each project. It was felt that the most efficient method of dealing with team members was to try to keep them together as much as possible after project completion.

Finally respondents were asked about other issues concerning reward structures and performance measurements which they might wish to discuss concerning new product development. None of the respondents wished to discuss facilitating structures, but a small number said that rewards were given to team leaders and team members according to the contribution made by each team member. However the majority said that extrinsic rewards were entirely the province of management and indicated that neither the team leader nor the team had much, if any, influence in this matter. Rewards were mostly in the form of company profit sharing.

4.7 Differences in the U.K. to U.S. approach to Team Leader Autonomy

In both countries the role played by top management in selecting the team leader is central but the implication is that in the U.S., management is able to achieve control in combination with the steering committee whilst in the U.K. these bodies appear to have a less important role. Committees appear to play a role in the selection of team leaders as well as in team selection. The initial research seems to indicate that in the U.S. management works in conjunction with the steering committee on matters relating to project selection and in some team matters. The U.S. respondents said their teams are empowered to meet design and deadline specifications, whereas in the U.K. one had the distinct impression that management operated in a more top down manner. The interviews conducted in the U.K. and the U.S. are, however, too few to enable much speculation about their differences. The subject of sampling is discussed in chapter 6.7.

4.8 Discussion and Summary of the Pilot Interview Research Findings

There is evidence from the pilot interviews to suggest that intrapreneurs/team leaders are not self selecting and that they are mostly appointed to the job by management. Management looks for technical expertise, track record and the ability to manage others. The level of decision making authority granted to the team leader did not appear to be high. Most of the decisions of a managerial or 'strategic' nature (as discussed in chapter 3.6) reside with management.

It would appear from interviewees' comments and feedback that the most urgent area for attention is the attitude and approach of management to team leader autonomy. Team leaders are only weakly empowered to take decisions of a strategic nature. In general, team leaders and teams tend to take day to day operational decisions with little input required by management. Objectives for projects are mainly set and monitored by management and therefore no data was obtainable on establishing a link between the team setting objectives and performance. Extrinsic rewards are primarily set by management in the form of a company-wide bonus and no evidence was found that the reward structure is linked to any form of performance criteria. Those interviewed described the activities of a team leader as being crucial to NPD rather than intrapreneurs. With the exception of a specialist management consultant most of those interviewed had little knowledge of intrapreneurs and this suggested that it could be difficult to discover how they are selected, managed and rewarded.

Based on the evidence of the interviews an opinion was formed that the team leader and the relationship to top management should now be the unit of analysis for further study. The team leader has some of the attributes and day-to-day responsibilities of the intrapreneur described in the literature. Therefore the original research intention of investigating intrapreneurs was narrowed down to researching the team leader in New Product Development manufacturing companies.

It was considered important by the researcher that investigation of the nature and degree of autonomy given to the team leader should be situated against a background of the company's external business environment and internal managerial controls. This requires knowing more about task environment and the hierarchical level of control which are important determinants of the type of control employed. In the next chapter we shall discuss a method for the classification of variables in the R&D process. In order to measure autonomy in the next stage of the research, we also needed to define some common manifestations of task autonomy to be used in the pilot and main studies. Therefore, as a starting point it was now necessary to re-examine the contents of the pilot interviews in order to gain further insight by using the grounded theory approach proposed by Strauss and Corbin (1990). This is the subject of the next chapter.

4.9 Summary of Chapter

The original objective of the research has been discussed and the reasons given for the change in direction from the study of the intrapreneur to the team leader. The stages of the research were explained and the objectives of grounded research discussed. A qualitative analysis of the interview results were given and the next phase of the research explained.

Chapter 5 Evaluating Qualitative Interview Data Based on Grounded Theory

5.1 Introduction to Chapter

Anyone interested in analysing qualitative data will ask themselves, from time to time, how can I make sense of all the material gathered? How can I be sure that my data is interpreted in a valid and reliable way? There are bound to be biases, prejudices and stereotypical perspectives that are likely to be included in the data. How can one pull the data together such that a meaningful analysis can be carried out? To address these issues, a grounded theory approach was adopted.

A grounded theory is one that is inductively derived from the study of the phenomenon it represents and for validation purposes needs to meet four central criteria for judging the applicability of theory to a phenomenon: fit, understanding, generality and control (Strauss and Corbin, 1990, p.23). If the theory represents everyday reality of the subject/s being studied and carefully induced from the data, it should fit that substantive area. Since it represents reality it should also be understandable and make sense to those practising in that area. If the data upon which it is based are comprehensive and the interpretations conceptual and broad in scope, it should be applicable in a variety of contexts and thus be general in nature. Lastly, the theory should provide control with regard to action toward the phenomenon.

Developing an understanding of phenomena may be achieved through the use of interviews which are a means of discussing with practitioners issues about a given subject, in this case issues associated with new product development. However, although one can obtain 'raw' data from the discussions it is by no means a simple matter to relate and understand the data. Generating a defined set of concepts to relate the data to can provide us with a means of identifying phenomena and themes.

Evaluating research as proposed by Strauss and Corbin is discussed and comprises a sequence of analyses known as open coding, axial coding, selective coding and the conditional matrix. This research does not make use of the conditional matrix which, according to Strauss and Corbin, 'is a powerful analytic tool for capturing the many conditions and consequences bearing upon a given phenomenon' (p.175). For the purpose of this research the evaluation of the pilot interviews was only taken as far as selective coding in order to define categories, dimensionalise their properties, describe a paradigm model and develop a model which describes the relationship between the central category and its sub categories. The final means of identifying and confirming the task variables discussed in chapter 3.6 is by a content analysis of the pilot interviews.

5.2 Open Coding

The method used to establish phenomena or constructs may be found in the book by Strauss and Corbin, *Basics of Qualitative Research*. The process starts by using a system known as 'open coding'

to develop a series of categories in terms of the properties they represent, which may then need to be dimensionalised. 'Properties are the characteristics or attributes of a category, whilst dimensions represent locations of a property along a continuum' (p.69). It is important to develop the properties and dimensions since they form the basis of establishing relationships between categories and any sub-categories that are the basis for understanding how grounded theory is developed. Open coding is a process of breaking down, examining, comparing, conceptualising and categorising data (Strauss and Corbin, 1990, p.61). In order to achieve this process we need to first identify the concepts involved which describe discrete happenings or events. Once the concepts have been identified and given labels it is possible to examine them and ask questions about phenomena. These questions will inquire into the events taking place in a process and will help to suggest how phenomena may be interrelated. In the process of open coding the data are subdivided into discrete category elements and compared for similar characteristics and differences which may exist. A category is also referred to as a 'phenomenon' and these will now be discussed by using table 2 and reviewing the categories and the properties observed in the literature and used in this work so far.

Categories	Properties	Task	Dimensional range
New Product Development	Development of Innovative Ideas		Technology Driven - Customer Driven
	Frequency of Projects		Never - Frequently
	Project Selection Criteria	S	
Capital	Budgets: Setting	S	Low - High Value
	Spending	S	Under - Overspending
Organisational Structure	Project Teams		Project Teams-various types of Matrix Team Structure
Project Technology	Project Design	O	Mediocre - Innovative
	Project Planning	O	On time - Late
	Project Scheduling	O	
	Implementation	O	Easy - Difficult
Participation	Decision Making		Low - High
Project Manager	Form of Management		Team Leader - Intrapreneurs
Project Resources	Team Selection,	S	
	Team De-Selection,	S	
	Rewarding Team Success	S	
Hierarchy	Authority, Degree of Autonomy		Low-High
Project Control	Reporting Frequency		None - Frequent
	Project Reviews	O	None - Frequent
	Project Evaluation	O	None - Frequent
	Project Deadlines	O	None - Frequent
Stakeholders (1)	Senior Managers		
(2)	Steering Committee		
(3)	Team Leader		
(4)	Team		

Table 2: Building Categories and their Properties

Tasks 'S' and 'O' in table 2 denote strategic or operational types.

Table 2 defines categories in terms of its properties, type of task and the dimensional range of the properties developed from the data. Some categories may have several properties and these will vary over the continuum and in some cases may be grouped together to represent a specific dimensional profile. All properties, except the stakeholders, have sub-properties which may also be dimensionalised if the analysis should require it.

Taking the first category, for example, we see that NPD (New Product Development) has as its property the development of new ideas. This has been dimensionalised by asking the question, are they technology or customer driven? One could visualise that customer ideas may be turned into successful product reality because they are, by definition, what the customer wants, but ideas simply based on technology may never become products and thus fail. Another property could be the frequency with which projects are undertaken. Innovative ideas put forward as NPD proposals may be of low or high frequency indicating the degree that NPD is a function of company renewal. The final category listed is that of stakeholders of whom we have mentioned just four.

5.3 Open Coding of Interviews

The application used for open coding here is to inspect all of the interview transcripts on a sentence by sentence basis and to focus on instances where a 'phenomenon' is referred to. Parallel to this approach the document, as a whole, is used to ask questions such as 'what is going on here?' Is this interview different in any way to the others that have been transcribed? If so, in what way? All fifteen interviews were analysed for content by the number of times a specific category was mentioned. This section will now contain the analysis of just two interviews used as examples, (number 3 and number 13) out the total of the fifteen depth interviews conducted. Both interview transcripts may be found with the appropriate annotations in appendix A, p.139

5.4 Summary of Two Interviews (content analysis)

Instances of category noted	U.K.	U.S.A.
New Product Development	10	3
Capital	3	0
Organisational Structure	5	2
Project Technology	3	0
Project Manager	1	3
Project Resources	1	1
Hierarchy	6	3
Project Control	5	1
Stakeholder 1	5	7
Stakeholder 2	1	3
Stakeholder 3	9	12
Stakeholder 4	4	7

Thus from just two interviews we have been able to identify the number of times that a specific category was mentioned by the respondent giving us a rough indication that these categories apply in the situations under discussion. The number of times a respondent mentioned one category more than three times might be a measure of its importance to the respondent.

Those categories in the two interviews mentioned more than three times were as follows:

	U.K.	U.S.A.
NPD	10	3
Organisational Structure	5	2
Hierarchy	6	3
Project Control	5	1
Stakeholder 1	5	7
Stakeholder 3	9	12
Stakeholder 4	4	7

5.5 Axial Coding

Having identified the core concepts of interest we can now move to axial coding which is a procedure for putting back together the data in new ways by making a connection between the categories. This is achieved by developing a paradigm model.

Strauss and Corbin (1990, p.96) present their model as follows:

Causal Conditions⇒ Phenomenon⇒ Context⇒ Intervening Conditions
⇒ Action/Interaction Strategies⇒ Consequences

The model may simply be defined as,

Causal Conditions:	Events, incidents, happenings that lead to an occurrence or development of a *Phenomenon*.
Context:	A specific set of properties that relate to a *Phenomenon*
Intervening Conditions:	The structural conditions bearing on *Action/Interactional* strategies relating to the *Phenomenon*.
Action/Interactional:	Strategies devised to manage or respond to a *Phenomenon* under a given set of conditions.
Consequences:	Outcomes of the action or interaction. They may take the form of a response to a given action/interaction, a counter strategy.

Using this model allows the researcher to describe actual occurrences. For example one model could be used to describe how categories are related as follows:

Causal Condition	⇒	***Phenomenon***
New Product Development		Team Leader Autonomy
Properties of NPD		***Specific Dimension of Team Leader Autonomy***
Project Selection Criteria		[Strategic - Low/High]
Human Resources		[Operational - Low/High]
Capital Requirements		[Shared Responsibility - Low/High]
Project Design and Implementation		
Project Control		
NPD Context	⇒	Degree of Project Control - Low/High
Intervening Conditions	⇒	Participation in Decision Making - Low/High
Action/Interactional	⇒	Building an NPD team to design a superior technology product
Consequences	⇒	Budget and Team Resource Management

Figure 4: A Paradigm Model (Strauss and Corbin, 1990)

A further example of the model may be described in the following terms:

It is the properties of the causal conditions (NPD) that lead to team leader autonomy (TLA) and we need to look at its specific properties and dimensions which are explainable by referring back to the causal conditions (NPD). Our focus however is on TLA and the interest in causal conditions is only as a means of being able to explain the degree of autonomy granted. Causal conditions, or antecedent conditions, are often indicated in the data by such terms as: 'when', 'why', 'how', 'due to' or 'as a result of'. A context represents the specific set of properties that relate to the phenomenon (TLA), that is the location of events related to the phenomenon along its dimensional range. Context may also be seen as a particular set of conditions within which the action/interaction strategies are used as a response to the need for TLA. It is in 'context' when stating that 'under conditions of NPD, we grant greater strategic autonomy to the team leader to schedule work and to determine the means by which to carry it out' (Hackman and Oldham, 1980).

It is now possible to think about the intervening conditions as the 'broader structural context' relating to the phenomenon. As an example, an NPD project has been approved, but the person suitable to lead the NPD team is not a member of your staff and needs to be recruited from another department, or from outside the organisation. Thus one has the issue of recruitment to consider. There is also the problem of continuity, what happens to the new recruit once the project is completed? Does he or she become a permanent member of the R&D department, or is the individual returned to the discipline from whence he/she came? The action/interaction also has certain properties, one of which is processual and evolving in nature. It is also goal oriented. Thus we can see from the previous paradigm model (above) that an NPD team needs to be built to meet the demands of design. The action/interaction taken in response to the need for team leader autonomy has an outcome, or consequences. The consequences may be events or happenings, such as the failure to meet project deadlines, or they could be the result of a customer demand for a specific design feature. Thus the consequences of one action could become part of the conditions for the next action/interaction sequence, for example more or less management control. In short, axial coding attempts to re-instate connections between the categories and their sub-categories, should there be any. The objective here is to establish categories that go beyond single properties and their dimensional range.

Axial coding may also be regarded as a process by which statements denote the nature of the relationships between them and a phenomenon, or phenomena. For example if we ask the question 'is NPD related in any way to team leader autonomy as a consequence of a company strategy to enhance job satisfaction or create the feeling of project ownership?' According to the literature, it is related in this way. In order to determine a connection between categories we may inspect the interview data to see whether the evidence supports the discussion questions used as a basis for the interviews. Each interview must be checked to see whether the respondents are concerned with a specific set of categories or if there are differences or variations that could add to our understanding of the process. In the event that differences are found which indicate an alternative approach, it would be necessary to investigate these differences. Strauss and Corbin (1990) also refer to the use of theoretical sensitivity which is based on the experience of the researcher and aims to discover what is not always immediately apparent and help to stimulate the inductive process. The above, in part, reflects the background and experience of this researcher in interpreting data extracted from the pilot interviews.

If we take the events in a typical NPD discussion such as that taken from Barczak and Wilemon (1992, p.66) we may follow the sequence: 'Our findings suggest that NPD (*Causal Condition*) project leaders need both freedom and autonomy (*Phenomenon*) to successfully manage their projects (*Consequences*). In other words, project leaders require (*Intervening Conditions*) the authority to select people (*Action/Interaction Strategy*) for their team, and make decisions about technical problems, set goals, budgets and schedules, and determine, assign, or negotiate roles and

responsibilities (*Consequences*)'. Thus the inductively developed model can be applied to the literature on NPD.

Validating the theory against data completes its grounding and this can be achieved by considering an actual application. For example, using the events taken from the first part of Pilot Interview 3 we may apply the categories and properties as follows:

> 'As Project Manager (*PM*) - Team Leaders (*Stakeholder 3*) communicate directly to the Executive Committee *(Stakeholder 2, Proj. Selection Criteria*) without project manager in the middle. Only when Team Leaders *(Stakeholder 3)* can communicate in a very concise fashion or when the team *(Stakeholder 4)* needs input from Executive Committee *(Stakeholder 2).* On the present project the Team Leader (*Stakeholder 3*) is working with the CEO *(Stakeholder 1)* - the obvious expert. Ideally every project is that way without a project manager.'

> 'Resources Manager *(Stakeholder 1)* knows experience level of key staff *(Stakeholders 3 & 4)* - knows what they have done and are likely to be involved in. Tries to match people *(Team Selection/De-Selection/Rewarding Team Success*) with their interests. Team Leaders (*Stakeholder 3*) in pairs - always representative from marketing with technology representative. Several projects *(NPD)* are on-going at same time. Two project managers at the beginning of a project - one marketing and one technology. At the beginning of starting market requirements and studying the market, the marketing project manager would be in charge. This is a short phase. Then it moves into engineering design *(Project Design)* and construction (*Project Planning/Scheduling/Implementation*), testing (*Project Reviews/Evaluation),* which is considered factory work and that is the responsibility of the technology managers.'

> 'Technical writers, product marketing analysts, programming analysts, all work for the project manager. Team leaders would have complete authority and responsibility (*Budget Setting/Spending*) over their project, to the point that they talk directly to senior management *(Stakeholder 1).* If they want me (*Stakeholder 1*) to do anything they talk, but if not they produce their own status reports *(Proj. Reviews/Deadlines)* and go about their own business.'

Analysing empirical data in this manner enables a meaningful identification of the core concepts of interest.

5.6 Selective Coding

Selective coding is a process by which a central, or core, category is systematically related to other categories with an appropriate validation of each relationship that exists. The core category may be seen as the central phenomenon around which all the other categories are integrated. Categories have been explained in terms of their properties and dimensions and a paradigm model has been presented showing the relationships which exist and giving the categories more meaning and definition. What we now come to is the point of finding conclusions from the data gathered. It is at this point that we need to translate the rough form of the data into a conceptual, comprehensible representation of reality.

The simplified process may be described as follows:

1. Relate any subsidiary categories around the core category by using the paradigm model.
2. Relate the categories at the dimensional level and validate these against the data.
3. Categories not yet refined have to be filled in or developed further.

As the next step let us consider what NPD (New Product Development) is all about. New product ideas sometimes result in a decision being made by management to start a NPD project which requires resources in terms of funding, management support, selection of a project team leader and team. Financial needs must be budgeted and a planned call off period for the funds to be used will be set. Discipline skills need to be mustered and the appropriate fixed assets set aside for the project purpose. Control and monitoring mechanisms have to be decided and the co-operation of other disciplines such as marketing and production sought. This brief scenario is sufficient to illustrate the typical sequence of steps.

5.7 A Model of Task Sharing

Given the conceptualisation of the above story, we may now focus more analytically on the central phenomenon and the categories that surround it. As the central phenomenon we shall take NPD which encompasses all of the categories and thus becomes the core category and is, as Strauss and Corbin (1990, p.124) put it, 'the essential cement in putting together - and keeping together properly - all the components in the theory'. All of the elements may be constructed in a diagram of categories and sub categories.

The variables that define some common project tasks into 'strategic' and 'operational' components as derived in chapter 3.6 are inserted into their respective positions to indicate their relevance and linkage to the degree of task sharing among the four stakeholders as follows:

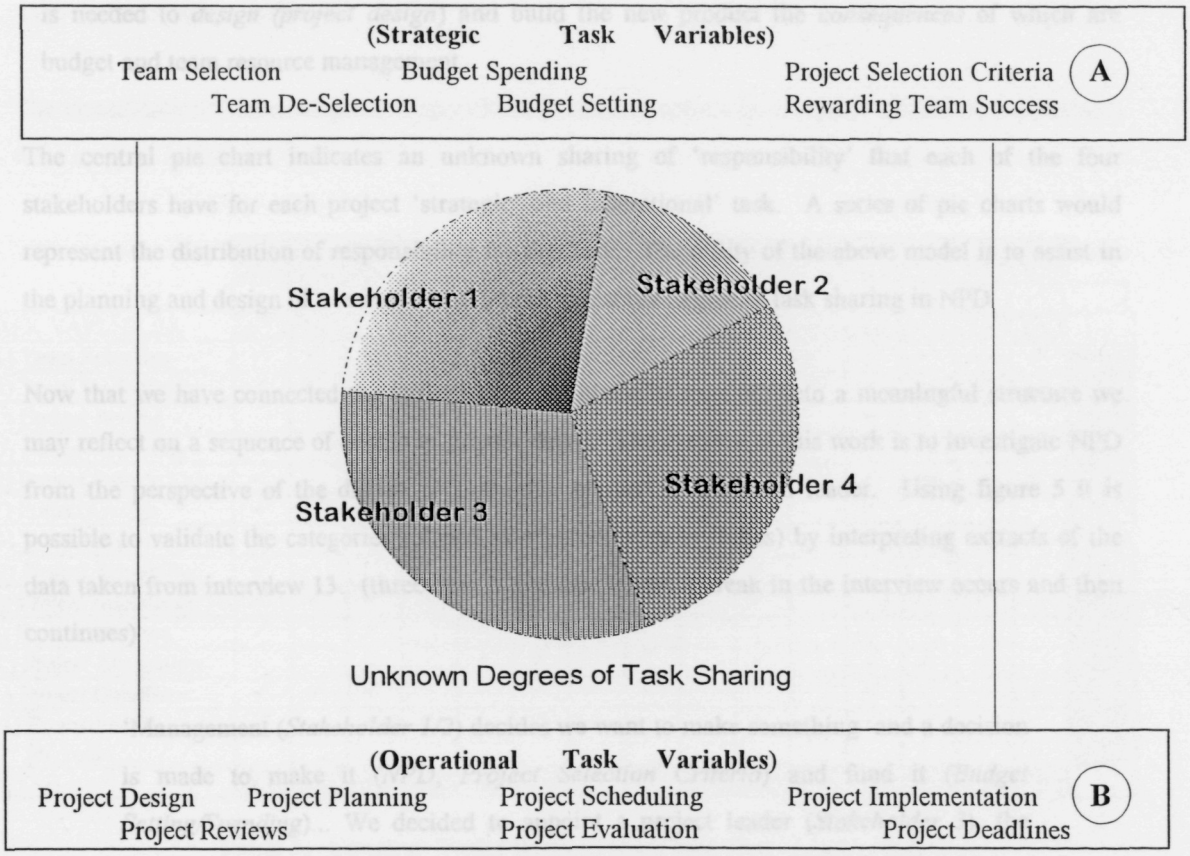


Figure 5: A Model of Task Sharing in NPD

Figure 5 links the task variables and the stakeholder categories to the NPD management process and consists of the main elements of the paradigm model given in figure 4. In the above model the Boxes 'A' and 'B' contain many of the properties listed in table 2 (p.64). These are:

(A)

(i) the development and implementation (project design/scheduling/implementation) of innovative ideas

(ii) the procedure and criteria used for project selection (*project selection criteria*)

(iii) the capital requirements (*budget setting/spending*)

(B)

In the NPD *context* we discussed the degree of project control (*project reviews/evaluation/deadlines*) exercised by management and the *intervening conditions* of the paradigm model related to the participation (*task sharing*) in the decision making process of the project. At the *action/interaction* level a team (*team selection/de-selection/rewarding team success*) is needed to *design (project design*) and build the new product the *consequences* of which are budget and team resource management.

The central pie chart indicates an unknown sharing of 'responsibility' that each of the four stakeholders have for each project 'strategic' and 'operational' task. A series of pie charts would represent the distribution of responsibility for that task. The utility of the above model is to assist in the planning and design of a research instrument to test the degree of task sharing in NPD.

Now that we have connected the various category elements together into a meaningful structure we may reflect on a sequence of events in greater detail. The essence of this work is to investigate NPD from the perspective of the degree of autonomy granted to the team leader. Using figure 5 it is possible to validate the categories (placed into parentheses in italics) by interpreting extracts of the data taken from interview 13. (three dots ... indicate where a break in the interview occurs and then continues)

> 'Management (*Stakeholder 1/2*) decides we want to make something and a decision is made to make it (*NPD, Project Selection Criteria*) and fund it (*Budget Setting/Spending*)... We decided to appoint a project leader (*Stakeholder 3*), the right kind of guy and allowed him to pick his own team (*Stakeholder 4, Team Selection/De-Selection*) from anywhere in the business... We co-located all the people (*Stakeholders 3/4*) into the same area and gave them a three day intensive team building experience to try and weld them into a fighting unit... What happens is that those who can manage different functions (*Project Design/Planning/Scheduling/Implementation/Reviews/Evaluation/Deadlines, Rewarding Team Success*) end up being seen as more mobile by the management *(Stakeholder 1)* and used in other areas. People who make things happen across the business don't see themselves as functional people. They ask themselves how to get things done and by whom. They interact with people, and get known for it'.

Finally, using Table 3 below as the basis for determining the task variables it was possible to extract the classifications from information derived from the interviews and discussions in general. A content analysis table was constructed using the interview transcripts in order to determine in which companies the task issues were mentioned. According to Silverman (1993), 'content analysis is an

accepted method of textual investigation, particularly in the field of mass communications. It involves establishing categories and then counting the number of instances when those categories are used in a particular item of text, for instance in a newspaper report' (p.59).

In the case of the content analysis of the pilot interview data a 'tick mark' (✓) denotes when a given 'task variable' was mentioned.

The classifications were assigned to specific task variable names from which a table of occurrences were mapped as follows.

	INTERVIEW NUMBER															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
TASK VARIABLES.																Tot
(A) Team Selection	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	15
(B) Team De-Selection	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	13
(C) Budget Setting				✓		✓		✓		✓		✓	✓	✓		7
(D) Budget Spending				✓		✓		✓	✓	✓	✓	✓	✓			8
(E) Project Selectn Crit.	✓			✓	✓			✓			✓	✓	✓		✓	8
(F) Project Design	✓	✓	✓		✓	✓	✓			✓		✓				8
(G) Project Planning	✓		✓		✓	✓	✓	✓		✓				✓	✓	9
(H) Project Scheduling	✓		✓	✓	✓		✓	✓		✓		✓		✓	✓	10
(I) Project Implement.	✓	✓	✓	✓		✓	✓	✓	✓	✓				✓		10
(J) Project Reviews	✓	✓	✓		✓	✓	✓			✓			✓			8
(K) Project Evaluation	✓		✓		✓	✓				✓		✓	✓	✓		8
(L) Project Deadlines	✓	✓	✓		✓	✓	✓	✓				✓	✓		✓	10
(M) Rewarding Team Success	✓		✓	✓		✓	✓			✓		✓	✓			8
TOTAL	11	6	10	8	8	11	9	9	3	11	4	10	9	7	6	

Table 3: Common Tasks Derived from Interview Transcripts

Table 3 represents a content analysis of common tasks mentioned by the respondents subdivided into the 'strategic' and 'operational' variables given in this section. These variables were used first in the pilot survey and then in the main study. In the pilot study, the tasks were used as 'categorical' data which were suitable for correspondence analysis. In the main study the task list was used in two questions which made them suitable for analysis as both categorical and interval data. Categorical data measured the degree of association with a given task and interval data was used as a measure of 'autonomy' granted to the team leader for a given task. Two examples of interview transcripts may be found in appendix A, page 139 which demonstrates the manner in which Table 3 was constructed.

Finally, the grounded theory in this chapter meets the four central criteria for judging the applicability of the theory to a phenomenon laid down by Strauss and Corbin in this section 5.1:

(a) *fit*, both the paradigm model (figure 4) and the task sharing model (figure 5) fit the categories and properties derived from the interviews and fit the substantive area being researched

(b) *understanding*, the theory is comprehensible and makes sense

(c) *generality*, it includes sufficient variation of companies and industry sectors to make it apply in a number of contexts related to the phenomenon being studied

(d) *control*, it could provide control with regard to action toward the phenomenon. This is because the proposed relationships among the concepts are systematically derived from actual data.

5.8 Summary of Chapter

The principles of evaluating qualitative interview data by grounded theory have been discussed. Open coding was used as a means of breaking down data and classifying interview data in terms of phenomena and their dimensions. Axial coding, designed for examining the core concepts, and selective coding were used as a means of relating categories for validation purposes and then utilised to examine the data. A typical paradigm model was constructed as a means of connecting the various categories and sub-categories and used with an actual pilot interview to demonstrate the utility of the model. A content analysis of all interview data further validated the task variables used in the research.

Chapter 6 Research Methods used for the Pilot Survey and Main Study

6.1 Introduction to Chapter

The pilot study explores the subject of team leader autonomy against the background of the external company environment and product markets. In this section we deal with the instrument on which the collection of data for the second part of the pilot research depends: the postal questionnaire survey. The chapter examines the principles of design, the structure of questionnaires and what can be done to reduce unwanted bias.

6.2 Research Methodology for the Pilot and Main Study

In chapter 4.2 we discussed how depth interviewing was an appropriate method to be used for qualitative research in the phenomenology paradigm, however for quantitative research such as is used in the pilot and main studies, a positivist approach was adopted as being more appropriate to the research objectives. Positivist theory was developed in detail during the early part of this century although its fundamental concepts can be traced back to the philosophers of the Enlightenment but it was the French philosopher August Compte who posited that the principles of natural science could be applied to the study of human behaviour. Positivism may take a number of forms, but there are some common characteristics (Halfpenny, 1982). In the social sciences one attempts to discover the factors which cause phenomena in much the same way that scientists construct various theories to explain the behaviour of dependent variables. Positivism maintains that knowledge should be based on real facts, not abstractions, thus knowledge is predicated on observations and experiment in contrast to the phenomenological paradigm of searching for the inner meaning or the essence of things. Easterby-Smith, Thorpe and Lowe (1991) emphasise the opposition between positivism and phenomenological approaches when they say that phenomenology 'stems from the view that the world and reality are not objective and exterior, but that they are socially constructed and given meaning by people.

The pilot and main studies of this thesis are concerned with data that can be recorded and measured, with results likely to display characteristics which are interrelated and have causal relationships, and are objective with a methodology which is independent of the researcher and may be replicated by others, thus these sections may be regarded as positivist. Positivists are concerned with the epistemological issue of measurement. The analysis of a problem is, in this paradigm, focused on hard fact (where possible) not opinion or general feeling about a subject.

6.3 Research Method

The distinction between quantitative and qualitative data is not always clear. Different techniques, such as interviews and observations can be used to gather data either quantitatively or qualitatively but if one is looking to sample and measure aspects of activity, such as NPD (New Product Development),

the technique typically used is quantitative in nature. The instrument used to acquire data in the pilot and main studies of this research is the postal questionnaire survey.

One important aspect of quantitative research is that the process of data collection is considered as distinct from analysis. The postal questionnaire is a method of obtaining specific information about a defined set of problems so that the data, after analysis and interpretation, results in a better appreciation of the problem. Similar arguments may be found in Chisnall, 1973; Hoinville Jowell and Associates, 1978; Moser and Kalton, 1989; de Vaus, 1990.

Using a structured postal questionnaire was believed to be the most efficient means of obtaining the information required because: a) it permits the researcher to address a larger population than would normally be possible using an interviewing technique when the population is spread over a wide geographical area, b) it allows the researcher to code answers ready for a computer file suitable for statistical analysis, c) in most cases it is demonstrably more cost effective, d) it enables a potentially larger number of people to answer identical questions, e) many of the respondents might feel better inclined to give more accurate answers when they already know that the questionnaires will remain anonymous and, f) given sufficient response, the structured questionnaire lends itself more readily to analysis by statistical techniques. It is also possible to construct questions which go beyond a simple yes or no. For example, one of the most common forms is that known as the Likert scale in which the respondent is asked to circle one answer category indicating the strength of agreement or disagreement with a statement.

Obvious disadvantages of questionnaire studies that must be allowed for are:

i) Respondents may not fully understand the questions, regardless of the care taken to simplify the meanings.

ii) Respondents cannot express shades of opinion.

iii) There is always a risk that some answers may contain strong positive or negative bias if respondents encounter phrases or terms which they either like or dislike.

iv) Some questions could be answered significantly differently dependent on how the individual happens to feel about a particular question on a given day.

v) Respondents might feel the desire to complete the questionnaire as soon as possible and not give a sufficiently considered response to some questions.

vi) Respondents are not seen by the researcher, who is unable to judge or question the response.

In the field of Industrial Marketing Research postal surveys have a poor image which we have examined in the previous chapter, but in addition to the issues described there is yet another problem in that postal questionnaires do not allow a subject to be discussed in detail such as in a face to face or even a telephone interview. Hague (1991) believes that this disadvantage can, in part, be overcome by

the wording of the questionnaire. Postal questionnaires are a specialised tool with an important role to play in research provided they are used in the right circumstances and with the necessary controls.

It seems to be widely agreed (Chisnall, 1973; Hague, 1991; Hoinville Jowell and Associates, 1978) that the researcher should know a great deal about the subject if he/she is to design a workable questionnaire. The types of questions asked should be easy for respondents to understand and answer so that the respondents are more likely to give valid and reliable information. In particular the stakeholder being questioned about other stakeholders may have strong views, especially if these questions involve any potential impact on their position. The term stakeholder used here is to denote any individual with an interest in the firm and who has the power to influence it, as was first discussed in chapter 1.3.

6.4 Validity and Reliability of Data

Easterby-Smith, Thorpe and Lowe (1991) suggest that one of the common fears of researchers from all persuasions is the question: 'will the research stand up to outside scrutiny and will anyone believe what I am saying about it?' According to Kirk and Miller (1986) the terms of validity and reliability were originally developed for use in quantitative social science. The concept of validity and reliability provides a very useful discipline for the 'positivist' researcher. Easterby-Smith et al believe that in addition to sampling theory, validity, reliability and generalizability are the questions to be considered within the context of a philosophical viewpoint. These are given as follows:

'Validity	Does an instrument measure what it is supposed to measure?
Reliability	Will the measure yield the same results on different occasions (assuming no real change in what is to be measured)?
Generalizability	What is the probability that patterns observed in a sample will also be present in the wider population from which the sample is drawn?'

(Easterby-Smith et al, 1991, p.41)

Validity may be expressed as in four ways:

'Construct Validity	what the instrument is, in fact, measuring'

(Churchill, 1987, p.384))

'Face Validity	whether the instrument or its items are plausible
Convergent validity	confirmation by comparing the instrument with other independent measurement procedures
Validation by known groups	comparing groups otherwise known to differ on the factor in question'

(Easterby-Smith et al, 1991, p.121)

For the purpose of this research both construct and face validity were possible. Construct validity is confirmed since the instrument used is traceable back to figure 5, p.71 that was developed from the constructs of 'strategic' and 'operational' autonomy by establishing a link between the task variables, a literature search (see table 1, p.49) and an empirical study (see chapter 4), and then validated through grounded theory (see chapter 5). Face validity was possible because the instrument was plausible for describing actual events which take place in NPD and was validated using grounded theory. We have seen in table 2 chapter 5.2 that categories associated with NPD were explained in terms of their properties and dimensions and a paradigm model presented showing the relationships. NPD categories were also related at the dimensional level and validated against interview data. The instrument may, therefore, be said to have both construct and face (or content) validity. However, convergent validity could not be confirmed since there was no other independent measurement procedure and validation by known groups was not possible, due to a size and selection limitation. However a comparison between similar samples of two countries, the U.K. and U.S.A. was made, but not for validation purposes. This would require an a priori model of the countries beforehand.

Reliability is mainly concerned with stability. Will the same result be obtained if the measurement instrument is used by the same respondent on a different occasion? Since two time frames are likely to be fraught with other problems concerning changes in conditions in which the respondent operates or other factors, it is more common to examine the 'equivalence reliability', or the extent to which different items intended to measure the same thing correlate with each other. According to Easterby-Smith et al (1991), exploratory research reliability coefficients in the order of 0.6 are acceptable. However, for this research, reliability coefficients in the order of 0.8 and greater are deemed to be better. Measures of reliability will be discussed in the additional analysis section of chapter 10.4.

Generalizability is a question about whether the general pattern of results may be representative of a larger population. As DeSanctis suggests:

> 'the goal of study is not generalization ... The results of any one well designed and carefully conducted study can provide important inputs to a long-term program of study. Though each study may produce some interesting, worthwhile findings, the real value of the research lies not in generalization of the immediate results but in the ultimate product of the program of research.'
>
> (DeSanctis, 1989, p.72)

Three methods could provide a route to generalizability: (i) split sample measurements, (ii) triangulation and (iii) demographic variables. Whilst split samples provide a means for comparison such a technique generally requires a large enough sample and this is not the case in the pilot study (or main study). Triangulation on the other hand could be a useful technique to use in the pilot and main study since we have data acquired by more than one means, interviews and questionnaires. However, although such a technique can help to balance the bias of using one approach it should not

be regarded as an excuse for poor data or the lack of rigour in any one area. Regardless of how reliable triangulated results might be their value is likely to be in question unless they add significantly to theoretical understanding. The third method of generalizability concerns the demographics of the respondent companies. Whilst this is less important for the pilot study due to the small sample, it is useful to have the summary statistics of the main study sample which could be a helpful starting point to other researchers wishing to make further investigation into this area. Generalizability of the main study findings is dealt with in chapter 8.9, p.104.

6.5 Questionnaire Design

The format of the questionnaires makes a difference to the final product. A poorly constructed questionnaire is likely to lead to a poor response rate, thus the following points were taken into account:

- Opening questions were non threatening (Sletto, 1940; Robinson, 1952; Erdos, 1957)
- Items were grouped into logically coherent sections
- Questions were numbered to avoid confusion
- A smooth transition between topics was made, rather than it seeming like a mass of unrelated data (Goode and Hatt, 1962)
- Pages were numbered
- Study Title was in bold type
- Clear but brief instructions for completing the form
- Overcrowding of questions on the page were avoided

The appearance and arrangement of the questionnaire can be a factor that could affect the outcome of the study. A well planned, carefully constructed questionnaire will, according to Berdie, Andersen and Niebuhr (1986) increase the response rate of the study and also greatly facilitate the summarisation and analysis of collected data. One article dealing with the response rate of mailed questionnaires by Levine and Gordon (1958) suggests that 'the appearance of the questionnaire frequently determines whether it is read or discarded. Once the respondent takes the effort to read it, he/she has some psychological commitment to complete it' (p.571).

According to Easterby-Smith, Thorpe and Lowe (1991, p.120) there are some rules of good practice for helping to simplify the filling in process. These are to:

> '1) provide a short covering letter explaining the purpose of the research and why/how the respondent was selected,
>
> 2) start the questionnaire with brief instructions about how to complete it,
>
> 3) vary the questions occasionally, but keep similar questions together,
>
> 4) start with simple factual questions, moving later on to items of opinion or values.'

6.6 Removal of Bias

A complete removal of bias is probably impossible, at best one can only minimise it. Biased replies could come from respondents if the questions relate to activities of a third party, therefore questions were only asked about matters directly relating to the personal experience of the respondent. In order to keep the bias to a minimum in the answers given to the questions, the following precautions were taken:

1. Opinions concerning a particular point were obtained by structuring a range of questions around the same theme. Provided the answers to the similar questions were consistent, the answers were taken as being valid.
2. Questions were structured such that opinion was sought about a specific point of interest rather than asking the same questions in a different form. This approach was preferred by Oppenheim (1966) who argues that attitudinal questions are more sensitive than factual questions to changes in wording and emphasis. He challenges the reliability of asking the same question in a different form. He does not believe that it is the same question.
3. Obvious points of bias such as 'leading questions' were avoided.
4. Terms used in the questions were kept as unambiguous and simple as possible.
5. Questions were of a nature that would be understood by the respondent. This was achieved by using feedback from the pilot interviews.

Not all the questions asked in the questionnaire are direct measures. For example, question one relates to the business classification. Its purpose is to identify to which industrial or product group each company belongs. Other questions involve the respondents providing information about market position over a given period and the levels of sales revenues spent on R&D the purpose of which is to attempt to identify any patterns of company activity and NPD productivity which might be associated with granting team leader autonomy. Questions eleven and twelve deal with primary responsibility for given tasks and areas in which team leaders might be given greater control.

Another method of reducing the bias is by being able to get a sufficiently large sample. The size and varied coverage of the sample used increased the likelihood that a representative viewpoint was obtained.

6.7 Sampling

Sampling theory is concerned with the study of the relationships between a population and the samples drawn from it (Chisnall, 1973, p.59). Processes using statistical inference, probability theory and clustering of similar data make it possible to reach certain conclusions about a population from a study of samples taken from it. The concept rests on the fact that a sample is chosen randomly which implies that every member of the population from which the sample is drawn has an equal probability

of being chosen. Research frequently reports estimates about the distribution of, say, sales, product life cycle, and market share which is typical for a given market sector. Often there is no alternative but to sample, as in the case of large populations. The quality of the whole sample can be judged by careful examination and testing of some small part. Sampling has several advantages; it saves money, time and effort, it frequently enables data of high quality to be collected, and it can provide data that could not, practically, be assembled by other means.

A part of the design choice is whether to attempt to sample across a large number of organisations or situations or whether to focus on a small number of situations and attempt to investigate them over a period of time (Easterby-Smith et al, 1991, p.34). This research is based on trying to sample across a large, representative, number of organisations in electrical/electronics manufacturers and control systems design companies in order to identify a pattern of main responsibility for a given number of project tasks.

6.8 Obtaining a Representative Sample

'The view that there is a constant percentage, often thought to be around 10% , which can be applied when sampling populations of kinds and sizes, is quite wrong' (Chisnall 1973, p.93). Determining the size of sample can depend on the basic characteristics one is looking for and the cost of obtaining it. Thus the sample size might vary for a number of reasons. There should be clear aims about what the research is trying to achieve so that the sample can be designed to specifically target the acquisition of the required data. In some areas of research it may prove difficult to get a representative sample. There are several reasons for this and de Vaus (1990) lists some of the requirements that the researcher needs in order to obtain a good sample:

- a knowledge of the possible companies willing to take part in the research
- a knowledge about the known number of potential candidates
- have access to the individuals and must have some control over who completes the questionnaire
- have an up to date list of potential respondents rather than an old list
- a large enough sample to be statistically significant

Before a sample survey can begin, it is essentially important to define closely the population which is to be sampled. The population should not be widespread and general but be highly specific, as was the case in addressing this survey to R&D managers or directors of development in commercial companies. Since it was not possible to include all potential NPD companies in the research, a compromise had to be made satisfying the statistical method of measurement. The main criterion was to 'construct a subset of the population which is fully representative of the main area of interest' (Easterby-Smith et al, 1991 p.122) which has been undertaken in this research. The companies used

for the pilot questionnaire were all manufacturing companies derived from the Dun and Bradstreet register of British Companies engaged in new product development with known R&D or development departments.

The participants selected for the postal survey were at the same level of management and experience as in the pilot interviews and consisted of R&D managers or managers of the product development department. The size of the pilot survey was less than would have been desirable, but this is almost always a function of availability and return rates. Most of the companies chosen for the pilot study had sales revenues in excess of £20m per annum and were manufacturers of low, medium and high technology employing more than 130 employees. The rest of the sample came from companies below £20m/annum sales revenue. The sales revenue and number of employees of chosen companies was arbitrary but these companies were known to have an established R&D department. The sample did include a small number of design consultancies under £1m per annum in the pilot study but it was felt that, in general, manufacturing companies below a £1m turnover would not generate sufficient profit to support an R&D department or have a true mix of stakeholders. Frequently heads of the development or R&D departments in small companies tend to include the owner/entrepreneur and this could be misleading when defining stakeholders.

The emphasis was placed on electrical/electronics manufacturers and control systems design companies with significant added value in a similar range of industries to the companies studied in the pilot study interviews. Some pharmaceutical/biotechnology companies were included in the survey but many of these companies' products have, typically, long product life cycles and are often restricted by national and international regulatory procedures. Nevertheless for general overview purposes it was deemed necessary to include some due to the often high commitment of these companies to R&D.

310 questionnaires were sent to R&D managers of companies engaged in the manufacture of low to medium to high technology products in the U.K. that range products such as hardware, instrumentation, components and software manufacture in order to gain an overview of task sharing across a range of industries and conditions. Using a similar sample mix in the main study also enables one to acquire an overview of task sharing which could then be stratified along industry or other lines, such as size and technology. SIC codes are provided so that industries may be cross matched or compared at any stage and may be found in table 4 on the next page.

SIC Code	Brief Description	Type of Manufacturer Used
72.2	Software Consultancy and Supply	Software Manufacture
30.02	Manufacture of Computers and other processing equipment	Hardware
33.20/2	Manufacture of Electronic Instruments and appliances for checking, testing etc.	Scientific Instruments
33.1	Manufacture of Medical Equipment	
33.3	Manufacture of Electronic Industrial Process Control Equipment	Industrial Instrumentation
32. 1	Manufacture of Electronic Valves, Tubes and other Electronic Components	Components Manufacture
none		Other (specified by the respondent)

Table 4: Standard Industry Classifications Used for Survey

Using SIC codes can be quite useful for cross matching but it should be noted that there is some overlap between classes and great care is needed when coding responses in order to reflect, as closely as possible, the industry sector to which it truly belongs. The next chapter will discuss how the distribution of responses was dealt with.

6.9 Summary of Chapter

The research methods used for the pilot survey were discussed including questionnaire design and methods of reducing bias. Important issues were raised concerning the design and layout of the questionnaire as well as potential problems with quantitative surveys. SIC codes were introduced.

Chapter 7 Pilot Study: Questionnaire, Method and Findings

7.1 Introduction to Chapter

This section of the work deals with the content of the questionnaire used in the pilot study and it reports the findings and discusses the interpretation of the data. A copy of the pilot questionnaire can be found in appendix B on page 147.

7.2 Questionnaire Content

The questionnaire is divided into two sections. The first part is a means of describing the sample and covers questions 1-10 that ask the respondents for information about the industry which the company operates in, its product markets and competitive positioning. It was thought that this information would be useful for summary statistics of company activity and could prove helpful in identifying any relationships which might exist between industry, company size and other demographic variables and team leader autonomy, particularly in the main study where the sample size would be considerably greater. The second part covers questions 11-19 which are designed to extract information about the company's management control system, the degree of sharing of project task responsibilities and the organisational structure. This data might be also be used to determine the association between the stakeholders and the sharing of task responsibilities. Question 11-19 are, structurally, traceable back to the model depicted in figure 5, chapter five.

The Firm

Q1) What is your company's main area of business?

It can be helpful to know in which business the respondent firm operates. Some industries are more competitive than others and firms from different industry sectors are of different size. The target businesses for this study are mainly in the technology sector. Thus the businesses chosen for the study all carry an element of technology whether they relate to manufacturing processes or intellectual property such as software design or involve innovative methods of offering a service, for example, financial or IT services.

Q2) In what range was the sales revenue for the financial year 1992-93?

Company size could be a major factor when studying differences in intra-company investment in new product development. Annual company revenues below the £5m level are possibly less likely to be sufficient to finance innovation in high tech product developments and were not considered in this study. Smaller companies are unlikely to have the infrastructure or internal mechanisms to support and promote a dedicated approach to innovation.

Product Market Variables

Q3) For your 3 highest sales revenue earning products during the period 1991-1993, what is the estimated product life cycle, market growth and market share?

The two market based measures are of realised growth and technology related revenues. In summary they are:

> '(i) the percentage of corporate revenues in the introductory and growth stages of the product life cycle.
> (ii) the percentage of corporate revenues resulting from new technology.'
>
> (Capon, Farley, Lehman and Hulbert, 1992, p.158)

Clearly, when dealing with market position, it could be useful to have information relating to the rate at which the market is growing. Market growth information is also requested. Clutterbuck and Kernaghan (1990, p.27) put forward the view that the measure of market growth rate is useful for determining whether the company is growing at the same rate as the market as a whole.

An important pre-requisite for any analysis of product life cycle, market growth and market share is the reliability of data. Everything will depend on the answers given by the respondents. The purpose of this question is to gain an idea of how the companies think they are performing and to see if there is some relationship with the task variables.

Q4) For your 3 most strategically important new products during the period 1994-1996, what is the estimated product life cycle, market growth and market share?

From the information given in this section, it should be possible to gauge whether the company will continue to involve itself in innovative design. It is suggested by some that companies sometimes need to carry out a marketing audit by analysing their product range within existing businesses and markets (Eisenberg, 1972; Pearson, 1977). The history and rate of development in terms of the products produced and the position they occupy could provide some insight into the future decisions that might be made about production and development policy. For example, an early product introduction could increase market share (Smith and Reinertsen, 1991, p.3).

New Product Development

Q5) For the last two years, give the approximate number of new products and estimate the percentage of total sales revenue.

These measures might serve to confirm the importance of the revenue derived from new product development and indicate if there is a change expected. The purpose of this question is to find out how much revenue was derived from new product introductions over the last 5 years. The data give an indication of the actual number of new product introductions coupled

with the revenue generated by them. Thus, it should be possible to see how much impact new product introduction has had on the revenue stream.

Q6) What percentage of products developed were completed on time?

This might be seen as a measure of entrepreneurial efficiency over the last two years. Here we consider how products are released on time. Coupled with other factors in questions 10-16 one might be able to judge the efficiency of companies in bringing products in on time. Any major delay in releasing new products to the market could have a profound effect both on profitability and competitive advantage.

Q7) In terms of Sales Revenue, what percentage of products over 1991-1993 were leading edge technology?

It was expected that R&D managers in manufacturing companies were familiar with the term leading edge. Generally, leading edge products tend to be innovative in nature and this information could give an indication of the percentage revenue earned by innovative products over the period from 1990-1993. The response provides an idea of the level of technology in the product innovations. This figure, coupled with information about product life cycle and market growth, could be an important indication of innovation. The higher the percentage of leading edge products produced by the firm, the higher the possible potential for both technology superiority and market leadership.

Q8) In terms of Sales Revenue, what percentages of products are planned to be leading edge technology during 1994-1996?

One of the steps in the strategic marketing process is that of market or competitive positioning. To achieve this 'the company has to have a general idea of what kind of offer to make to the target market in relation to the competitors offers' (Kotler, 1980, p.84). Market positioning suggests defining where the company and competitors stand in relation to market needs or attributes within the target market. An anticipated increase in the percentage of revenue derived from leading edge products could provide a good indication that the company is following an aggressive business strategy.

Q9) What is the market strategy for the 3 predicted highest sales revenue earning products in 1994-1996?

Abell and Hammond (1979) suggest that companies may orient their strategy to one of four to five possible market position strategies. The questionnaire suggests two of them that might be important strategic choices for innovative companies, Technology Leader or Market Leader (not necessarily a technology leader). The Technology Leader frequently has the leading edge over other companies in product design. However, although the company may

have a competitive advantage in technology, it does not signify that they command the largest market share. Sensitivity to the environmental influences is essential to strategic market planning (Abell and Hammond, 1979, p.55).

Q10) Over the period 1989-1993, what has been the average percentage of sales revenue spent on R&D?

The purpose of this question was to identify the emphasis on innovation. The question was designed to discover what percentage of the annual sales revenue is dedicated to product innovation. Adopting product innovation may be a strategy for gaining market share in an existing market or addressing a declining market. R&D is considered to be most profitable in mature, slow growth markets (Abell and Hammond, 1979) where the dominant producer can greatly influence industry profitability because companies must match the rate of decline of the dominant competitor's costs. Rothwell (1987) reports that a higher percentage of the total R&D budget spent on the project during the beginning and peak activity differentiated the more successful companies from the less innovative competitors.

The next section of questions addresses some of the issues about the stakeholders, task responsibilities and strategic and operational autonomy, and may be related back to the model in figure 5, chapter five.

Management Control and Team Leader Autonomy

Q11) Who has main responsibility for selecting the Team Leader?

The section on management (*Stakeholder 1*) control and team leader (*Stakeholder 3*) autonomy asks respondents to identify the individual or group with main responsibility for selecting project team leaders. Respondents have the opportunity to provide information about who selects the team leaders. It could be useful to know whether the decision rests with the management, or to what degree team leaders are self selecting.

Q12) Who is primarily responsible for the following tasks?

This set of questions is designed to identify the levels of accountability for a range of innovation activity. The question is subdivided into various areas of responsibility *(Task Responsibilities* - see chapter 3.6, p.49*)* which could give a clearer picture of the main responsibility mix. Question 12 (and question 7 and 8 in the main study, chapter 8) seeks to define the degree of association that exists between four stakeholders and a number of task variables. Since the purpose of the instrument here is to measure the degree of task sharing between the four stakeholders it should have both construct and face validity. The question items used are traceable back to figure 5, p.71 that establishes a link between four stakeholders and thirteen task variables which were operationalised from the constructs of

'strategic' and 'operational' autonomy through a literature search (see table 1, p.49), an empirical study (see chapter 4), and then validated through grounded theory (see chapter 5). The instrument may, therefore, be said to have both construct and face (or content) validity. The more boxes ticked under the team leaders and team sections, the more responsibility is being delegated downwards. Morris, Avila, and Allen (1993) discussed the emphasis placed on individualism which has a direct causal influence on the amount of entrepreneurial behaviour evidenced within the firm. They believe that individualism includes the amount of personal freedom permitted.

Other writers and researchers have discussed individual autonomy (*Strategic and Operational Autonomy*) which, together with project ownership (Davis and Taylor, 1975; Hackman and Oldham, 1980; Slocum and Sims, 1980; Peters and Austin, 1985; Breaugh, 1989; Stevenson and Jarillo, 1990; Klein, 1991) and risk taking (Maidique, 1980; Drucker, 1985; Pinchot, 1985; Brandt, 1986) tend to advance entrepreneurial activity.

Q13) Given adequate managerial competence, what degree of control do you think the team leader should have?

This should give an indicator of where managers (*Stakeholder 1 and 2*) believe more autonomy could be given. It is also a good sign of management's predisposition towards decentralising authority *(Strategic and Operational Autonomy)*. It aims to assist in determining where more autonomy (*Task Responsibilities*) could be given to team leaders (*Stakeholder 3*).

Organisational Structure

Q14/16) Team Information

This should provide a measure of the span of control exercised by the team leader, the team (*Stakeholder 4*) size, and the number of teams in which a team member works at any one time.

Q17/19) Management Structure

These final questions concern the organisational structure, the number of teams (*Stakeholder 4*) managed by the team leader (*Stakeholder 3*), and the average size of the team (*Stakeholder 4*). The number of levels of management (*Stakeholder 1*) between the team leader and the board (*Stakeholders 1 and 2*), and the number of direct reporting relationships of the team leader, provides information about how tall or flat the organisation is.

7.3 Synopsis of Questionnaire Content

A synopsis of the topics covered in the questionnaire items are given in Table 5. A full copy of the pilot questionnaire can be found in appendix B on page 147.

The firm	
Q1	Area of business
Q2	Size of revenues
Product market variables	
Q3,4	Product life cycle data (Capon et al, 1992)
	Market growth rates (Abell & Hammond, 1979)
	Market share data (Capon et al, 1992)
New product development	
Q5	Number of new products produced and the revenues derived
Q6	Percentage of products completed on time
Q7,8	Number of leading edge products produced
Q9	Market Strategy
Q10	Percentage of sales revenue spent on R&D (Rothwell, 1987; Maidique & Hayes, 1988)
Management control and team leader autonomy	
Q11	Main responsibility for selecting team leader
Q12	Project management tasks and responsibilities (Bailyn, 1985; Feldman, 1989)
Q13	Future degree of control/autonomy for tasks (Manz, Keating & Donnellon, 1990)
Organisational structure	
Q14	Average number of teams managed by team leader
Q15,16	Average size and number of product development teams that a team member belongs to
Q17,18	Levels of management between team leader and board
Q19	Number of direct reporting relationships of team leader

Table 5: Questionnaire Topics

7.4 Questionnaire Response

The number of questionnaire replies received from the pilot survey totalled 46 of which only 38 were useable for the analysis. The eight other replies were unuseable and consisted of either a brief note explaining why the respondent company did not wish to participate or the questionnaires contained too many missing data to make a useful contribution. A breakdown by SIC (Standard Industry Classification) in table 6 shows the distribution of the response by industry sector. The '*' in the SIC column denotes that no SIC code is appropriate.

			Sample	Respondents
	Industry Sector	**SIC**	%	%
1.	Software Design	72.2	19%	13.2%
2.	Hardware	30.02	26%	36.8%
3.	Scientific Instrumentation	33.20/2	10%	2.6%
4.	Industrial Instrumentation	33.3 33.1	15%	10.5%
5.	Components Manufacture	32.1	14%	15.8%
6.	Other	*	16%	21.1%
	Summed Total		100%	100%

Table 6: Comparison of Sample Response Rate to Sample

As suggested in chapter 6.8 there is some overlap between classes and great care is needed when coding responses in order to reflect, as closely as possible, the industry sector to which it truly belongs. SIC code 30.02 classifies it as 'Manufacture of Computers and other processing equipment'. The questionnaire identified this item as 'Hardware' and includes power supplies, process controllers and ancillary computer accessories such as printers, tape drives and servo systems. The approximate response rate split between software/computer related hardware devices and the rest is 36/64. Thus software related devices account for 13.2% and other hardware devices account for 23.6% (total 36.8%). Although the spread is not uniform only scientific instrumentation is not well represented.

A table giving the summary statistics for sales, product market variables and R&D spending for the whole U.K. sample may be seen below:

Variable	Mean	Minimum	Maximum	N. Cases
SALES (approx.)	£18.4m	<£1.0m	>£50m	38.0
PLC (months)	85.0	9.0	240.0	34.0
MGROWTH (%)	14.0	-20.0	60.0	32.0
MSHARE (%)	31.0	3.0	70.0	31.0
RDSPEND (%)	13.8	2.0	50.0	34.0

Table 7: Summary Data of Product Market and R&D Spending Variables in the U.K. Pilot

From the above table one is able to get an overview of the product market and R&D spending data in the U.K. sample. The respondent company target of >£20m/ annum has a mean value which is slightly lower, at £18.4m, but this is due to the inclusion of some companies with an annual turnover

of less than £20m/annum for the reasons given in chapter 6.8. The purpose of requesting data of this nature was for possible comparison purposes.

7.5 Analysis of Pilot Study Findings

The data used to construct Table 7 and all questions relating to the number of products produced, revenue derived, market positioning and the strategy for new products indicated that they were inconclusive determinants of task/responsibility sharing since the distribution of the data was such that it produced too few groups of observations to make a meaningful analysis. However, with more observations, or a larger sample, it could be feasible to use product market data as a means of stratification in order to determine whether there are factors that influence the distribution of task autonomy. Only question 12 concerning who has prime responsibility for 'strategic' and 'operational' task variables had a sufficient number of observations which would permit an analysis using the correspondence analysis technique. These were then coded and analysed using the SPSS-ANACOR procedure in correspondence analysis.

Researchers are constantly faced with the need to 'quantify the qualitative data found in nominal variables' (Hair, Anderson, Tatham and Black, 1995, p.513). Correspondence analysis differs from other interdependent relationships in its ability to accommodate both non metric data and non linear relationships and performs a type of perceptual mapping similar to multidimensional scaling where categories are represented in the multidimensional space. The distances that ANACOR approximates are not ordinary distances, they are weighted. These weighted distances are based on the concept of 'mass', the centroid of which may be compared to a form similar to the 'centre of gravity'. Variable or category proximity indicates the level of association among row or column categories. Categories positioned closely together indicate high association and the possibility of combining the categories into a single entity. Correspondence analysis is a technique for displaying the rows and columns of a data matrix (primarily, a two way contingency table) as points in dual low-dimensional vector space (Greenacre, 1984, p.54). Once the dimensionality has been established, one can then identify a category's association with other categories by proximity. The charts presented in this work display two sets of points. One represents 'tasks' and the other 'responsibilities'. Interpreting the ANACOR results in SPSS depends on the normalisation method selected. Normalisation is used to distribute the inertia over rows and column scores. Since the interest is in obtaining a solution that describes the differences or similarities between the two variables, the canonical normalisation was chosen. Appendix C, page 160 - 162 provides the reader with a synopsis of interpreting ANACOR results. Some of the data obtained using ANACOR will be presented in this text. The remainder is in appendix D on pages 163-167. The output from a contingency table may be converted into frequencies of individual cells from which the SPSS programme is able to compute the variances and correlations of singular values for both rows and columns. If the variance is large, ANACOR will be

uncertain of the location of the point in the population. However, if the variance is small, ANACOR is reasonably sure that the point is located very close to the position indicated in the solution.

The data presented here relate to the association of the tasks and responsibilities listed in question twelve. The locations of tasks are used as a means of indicating their association with responsibility which are representative of the degree of autonomy present in the sample of respondent companies and taken as an indication of current management practice. In the results section of this chapter a comparison of tasks and responsibilities will be made between four of the company's stakeholders:

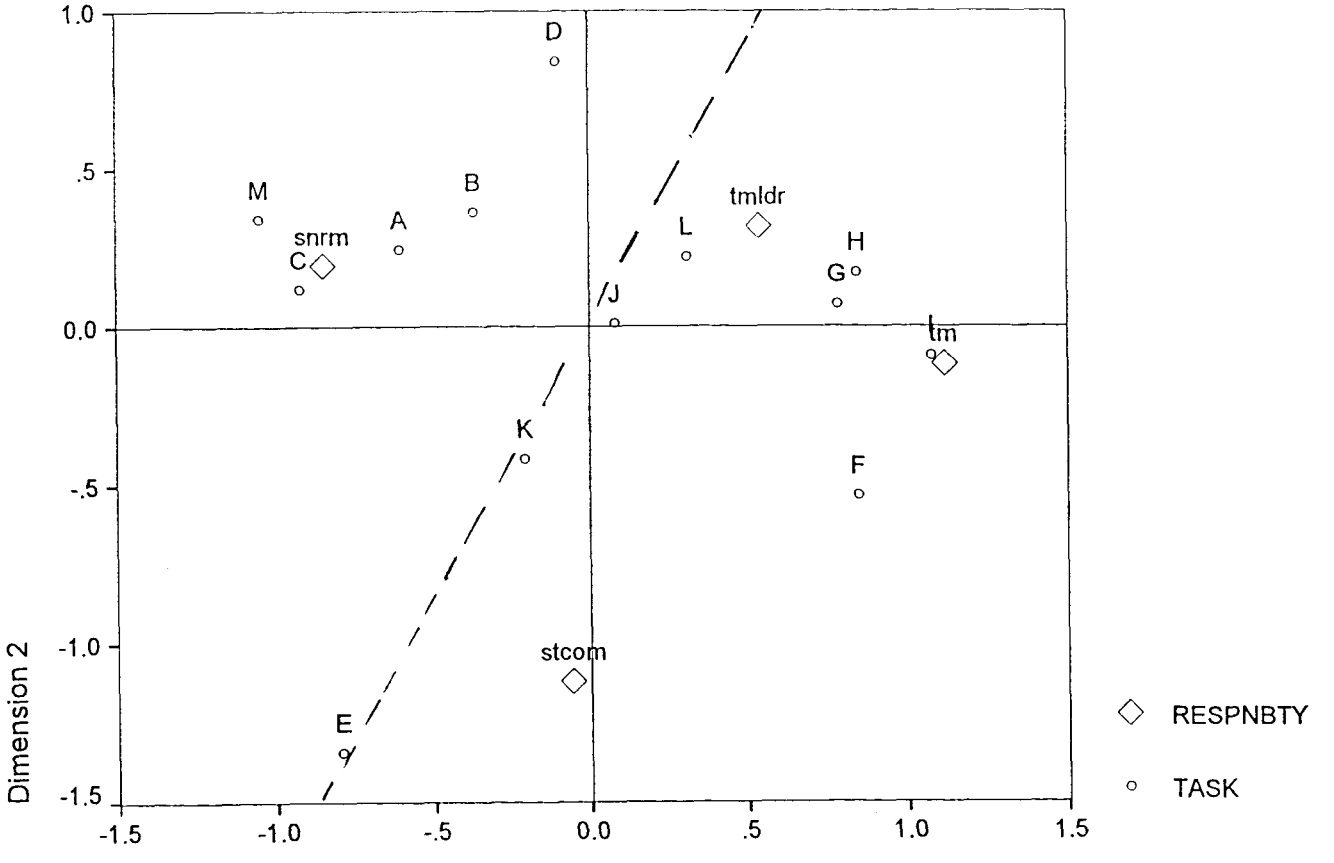
1	Senior Management	snrm
2	Steering Committee (sometimes referred to as 'representative' committee)	stcom
3	Team Leader	tmldr
4	Team	tm

As a note of explanation the senior management and the steering committee are typically at board level, or just below. Senior managers are those who use formal authority to organise, direct or control responsible subordinates (and therefore, indirectly, the groups or units which they may head) in order that all service contributions be co-ordinated in the attainment of a corporation's purpose. They are those generally charged with decision making at the highest level in the company: 'The managers must determine the degree and type of specialisation to be effectuated within the enterprise, and they must determine the relationships that are to exist among the specialised units' (Tannenbaum, Wechsler, and Massarik, 1961, p.255). The steering, or executive committee may be at board level, but not necessarily. Some members of the steering committee may be senior discipline managers that bring their level of expertise to the group.

Figure 6 (page 93) represents the pilot study solution of question 12, which shows how tasks and responsibilities are associated and may be interpreted as an indicator of how autonomy in this sample is distributed. Since the full labelling of charts in this work can easily become overcrowded and difficult to read, the tasks have been labelled A to M as follows:

(A) Team Selection
(B) Team De-selection
(C) Budget Setting
(D) Budget Spending
(E) Project Selection Criteria
(F) Project Design
(G) Project Planning
(H) Project Scheduling
(I) Project Implementation
(J) Project Reviews
(K) Project Evaluation
(L) Project Deadlines
(M) Rewarding Team Success

Task/Responsibility Associations



Canonical normalization

Figure 6: U.K. PILOT STUDY 38 Cases

Stakeholders

(snrm) Senior Management)
(stcom) Steering Committee
(tmldr) Team Leader
(tm) Team

Strategic Variables

(A) Team Selection
(B) Team De-Selection
(C) Budget Setting
(D) Budget Spending
(E) Project Selection Criteria
(M) Rewarding Team Success

Operational Variables

(F) Project Design
(G) Project Planning
(H) Project Scheduling
(I) Project Implementation
(J) Project Reviews
(K) Project Evaluation
(L) Project Deadlines

7.6 Scales

The scales of the chart in figure 6 may be interpreted as follows. Two dimensions are given: one on the 'X' axis and one on the 'Y' axis. An inspection of table 8 shows the proportion of inertia explained by each dimension together with the cumulative proportion. Whilst the second dimension contributes almost 20% (19.4%) to the total inertia, the graph might almost be interpreted in a single dimension. It may also be seen that 96% of the proportion explained is represented in just two dimensions which will be discussed in section 7.7.

Dimension	Singular Value	Inertia	Proportion Explained	Cumulative Proportion
1	.50202	.25202	.766	.766
2	.25242	.06372	.194	.960
3	.11536	.01331	.040	1.00
		--------	--------	--------
Total		.32905	1	1

Table 8: Dimensionality

On the horizontal 'X' scale (Dimension 1) are the relative positions of the tasks. To the right of the 'dotted' line, the tasks appear to be associated with 'project orientation' such as: F (project design), G (project planning), H (project scheduling), I (project implementation), J (project reviews), K (project evaluation) and L (project deadlines). To the left of the 'dotted' line, the tasks appear to be more closely associated items of a strategic management nature such as: A (team selection), B (team de-selection), C (budget setting), D (budget spending), E (project selection criteria) and M (rewarding team success). The oblique dotted line is probably due to the effect of being drawn over by the second dimension. 'Responsibility', marked by diamonds in figure 6, has divided into 4 quadrants.

The chart in figure 6 represents the overall solution of Question 12 and indicates the groupings of responsibility versus task. The chart scales can be interpreted as showing two groups of tasks, those associated with *strategic* tasks and the other associated with *operational* tasks. The first major task cluster appears to be around the position of senior management. This would indicate that, in general, senior management has the 'strategic' task responsibility for Team selection, Team de-selection, Rewarding team success and Budget setting. The second major cluster appears to be around the team leader and Team indicating that the 'operational' tasks Project Reviews/Evaluation and Deadlines (J, K and L) are more associated with the team leader, and 'operational' tasks Project Design, Planning and Implementation (F, G and I) are associated with the Team, with some interaction (not surprisingly) with the team leader.

7.7 Goodness of Fit

The variances for singular values in the data in the ANACOR table (see appendix D, pages 163-167) are small, as are the correlations between the two dimensions. This indicates that a good solution has been reached and that it is very unlikely that a different solution would be obtained if the two dimensions were exchanged for a slightly different sample.

SPSS defines the total inertia as the weighted sum of all the distances to the centroid divided by the sum of all cells in the correspondence table. The maximum number of dimensions produced is given by (r,c) -1, which in this case is 2. The first dimension displays the largest amount of inertia contributed and the second dimension follows with the next largest.

An inspection of the inertia per dimension in Table 8 (p.94) indicates that 96% of the total inertia is accounted for in two dimensions. Thus a two dimensional solution is acceptable.

Table 9 describes the contribution of dimension to the inertia for each column point.

RESPONSIBILITY	Marginal	Dim		
	Profile	1	2	Total
Senior Manager	.364	.968	.026	.994
Steering Committee	.159	.005	.982	.987
Team Leader	.372	.808	.141	.949
Team	.105	.882	.005	.887

Table 9: Contribution of Dimensions to the Inertia

7.8 Discussion of Pilot Findings

The objective of this section of the research has been to inquire into the distribution of task responsibility and possible determinants in new product development projects. With the exception of providing interesting descriptive product market data, all questions up to, and after, question 12 produced inconclusive evidence of a relationship with any of the tasks variables. Only question 12 indicated associations between the four stakeholders and the task variables and this will be the focus of the discussion.

The evidence presented here suggests that in most cases team leaders in the companies sampled do **not** enjoy a high level of 'strategic autonomy' (Bailyn, 1985; Raelin, 1989). On average, in the sample of companies surveyed, no evidence has been found to suggest that company top management is flexible in its approach to decentralisation. The data analysed supports the view that the preference of companies in new product development is towards maintaining managerial control over strategic

entrepreneurial activities. The present research has demonstrated that autonomy and control, in general, resides with the senior management. The factors which emerge as being primarily under senior management control are team selection and de-selection, budget setting and rewarding team success. One interpretation of these results is that companies in general do not delegate much 'strategic' autonomy to team leaders and that management is very much top down, but this may be a reflection of sample size and company cross section. It is recognised that there are limitations to what can be achieved in a small sample of this nature.

This raised important questions for further research and revealed a need to test the pilot findings in a wider sample. In particular, there was a need to more accurately assess the degree of both 'strategic' and 'operational' autonomy shared between the four stakeholders and to accomplish this through the use of a larger sampling frame. It was therefore decided that the main study questionnaire would only address questions relating to measures of task responsibility and team leader autonomy. However, as in the pilot study, there remained an interest in having details about industry, company size and product market data, as well as team leader selection methods, for possible sub-sample comparisons.

7.9 Summary of Chapter

The pilot questionnaire was discussed and it has been explained how it is broken down into the firm, product market variables, management control and organisational structure. Response rates were discussed and the pilot study results reflect in part the findings of the pilot interview data. It was decided that team leader autonomy be measured on a larger sample in the next phase of the research.

Chapter 8 Main Study: Method and Findings

8.1 Introduction to Chapter

The method of research for the main study conducted by questionnaire survey is described. The findings are reported and data analysed. Descriptive statistics are given and correspondence analysis is used to characterise the data and identify task sharing in the NPD project process.

8.2 The Position Following Pilot Survey Results and Prior to the Main Study

In the pilot study interviews, the general consensus among interviewees was that they felt constrained by their lack of authority. A number of the respondents suggested that if they were given more managerial autonomy (which we have now identified as strategic autonomy) project/team leaders were confident of being able to produce more product output in a shorter time span than they can currently produce. The pilot study postal survey confirmed that only 'operational autonomy' is widely given to project/team leaders. 'Strategic' autonomy remains the prerogative of senior management.

The main study now addresses a larger sampling frame and focuses its attention on team leader autonomy in NPD projects.

8.3 Questionnaire Content

In the design of the final research instrument (see appendix B, pages 147-159) some of the questions were eliminated from the pilot research questionnaire and others added. The reason for the thrust of the main study was discussed in chapter 7.8. viz, 'inquire into the distribution of task responsibility and possible determinants in new product development projects'. The main study questionnaire was intended to provide a broad picture of NPD task autonomy of the team leader and three other stakeholders. Also, using the data in terms of industry, product market data, percentage of annual sales revenue spent on R&D and the system used to select team leaders, it was expected that sub sample comparisons could be made. This data provides useful descriptive information of the sample and could be used for stratifying the sample.

A brief explanation of each question up to question 7 is given. Question 8, however, requires a more detailed explanation since it introduces a different technique of measurement the findings of which will be discussed in greater detail in chapter 10.3.

Questions 1-4 requested information concerning the main area of business, the annual sales revenue, demographic variables and the percentage of sales revenue spent on R&D. Questions 5 and 6 asked for information concerning who has responsibility for team leader selection and the methods used and was also expected be useful for stratification of the sample. Question 7 (has the same construct and

face validity as question 12 in the pilot study) asked respondents to indicate who has prime responsibility for a given set of project tasks and was the main question used to determine the degree of responsibility of each stakeholder. Both questions 7 and 8 use the same variables as in question 12 of the pilot study, but the order of questions has been varied in order to minimise the 'similarity' effect (format response bias), for example team issues, budget issues and project issues always being grouped together.

Question 8 was new and was expected to facilitate a measurement of the degree of both 'strategic' and 'operational' autonomy given to team leaders as described in the autonomy map discussion in chapter 3.5. The previous question (Q7), involved a measure of analysis based on categories. The main analysis of task autonomy is assessed by means of correspondence analysis which is a means of quantifying categorical data in low dimensional space. However, the scale chosen for question 8 is a seven point Likert scale. Likert (1932) published a paper 'A Technique for the Measurement of Attitudes' in which he described a method of scaling attitude. This has become known as a Likert Scale. Likert's method is relatively straightforward. It involves reducing a large number of statements to form a final scale. In his work a number of people responded to a large number of attitude statements in which they gave their own responses rather than attempted to arbitrate as judges.

Gillian Courtenay (1978) points out that Likert used five point scales for each statement from 1-5. By adding together the respondent scores, a summated score is derived as a basis for a first approximation of the scale position for each statement. The statements found to discriminate most clearly between the extreme groups are the ones that form the final Likert scale rating. Likert is not an interval scale but is monotonic, that is the successive members either consistently increase or decrease but do not oscillate in relative value. According to Chisnall (1973, p.175) scores achieved by individual respondents are only relative to other respondent scores. Chisnall further points out that Likert scales are popular because they have been shown to be very reliable and simple to construct.

For the purpose of constructing an autonomy map in this work the scales were summated and averaged along similar lines to the construction of the map proposed by Bailyn (1985) which shows the relationship between strategic and operational autonomy and has been described in detail in chapter 3.5. The findings of the autonomy maps for both the U.K. and U.S.A. are given in the supplementary chapter 10.2.

The Likert scale is also frequently used for factor analysis, thus the data of question 8 was further examined to determine underlying dimensions or relationships for a large number of variables (Hair, Anderson, Tatham and Black, 1995, p.365) connected with project management issues and these too are given in chapter 10.3.

8.4 Sample

The postal questionnaire for the main study of the research was developed from the two previous research efforts made between February 1993 - September 1994, both of which have been reported in earlier chapters. The pilot study reported in chapter seven was based on inputs from British based companies. In the main study a much larger sample was used and enabled separate analyses of stratified samples to be made. The researcher was also interested in making comparison of similar companies in the U.K. and the U.S.A. in order to see whether there were any significant differences in approach to task sharing. The findings of both samples are subsidiary to the main study and are reported separately in chapter nine.

Questionnaires were sent to senior R&D managers in both the U.K. and U.S.A. In each case the aim was to concentrate as much as possible on companies with a technology base in electrical/electronics manufacturers and control systems design and an active research and development department. Using the standard industrial classification codes given in chapter 6.8 and summarised below, the sources used for extracting potential respondents in the U.K. were:

(a) Dun and Bradstreet Directory of British Companies,
(b) Market Monitor Ltd, a mailing list of Directors of R&D.

The main aim was to select companies with an annual sales turnover in excess of £20m and employing 130 persons or more in electrical/electronics manufacturers and control systems design companies with significant added value and with a known R&D department. However, due to the low numbers of companies that met these criteria (640), several of the respondents came from medium and small batch manufacturers with less than 130 employees, thus relaxing the criterion of company size to a turnover above £5m/annum. The six industry sectors are given below.

- Software Manufacture
- Hardware
- Scientific Instruments
- Industrial Instrumentation
- Components Manufacture
- Other (to be specified by the respondent)

A complete breakdown of the U.K. by population of companies of >£5m sales per annum and the actual sample used by company types and by industry and SIC code is given in table 10.

BUSINESS		TOTAL POPULATION			RESPONDENTS	
	Industry Sector	SIC	COUNT	%	COUNT	%
1.	Software Design	72.2	332	13%	39	20.1%
2.	Hardware	30.02	324	12%	74	38.1%
3.	Scientific Instrumentation	33.20/2	173	7%	11	5.7%
4.	Industrial Instrumentation	33.3 33.1	1220	48%	12	6.2%
5.	Components Manufacture	32.1	508	20%	12	6.2%
6.	Other	*			29	14.9%
	Summed Total		2,557	100%	194	100%

Table 10: Summary Data of U.K. Industry Sectors

Table 10 represents the total population of the possible sample and the actual sample received. The SIC code for 'other' is represented by a '*' since these involve small batch manufacturing companies and design consultancies for which no single SIC code appeared appropriate.

Computing the size of sample needed can be a complex process (Chisnall, 1973, p.94) but in this sample of companies taken from the Dun and Bradstreet register of British companies, only those companies known to have an established R&D function, and where the name of the individual R&D director was known, were used. Therefore, the number of targeted individuals responsible for the R&D function constituted 100% of the named individuals from the total population.

Out of the total population of companies meeting the criteria of >£5m sales per annum 770 (30%) of the companies were used for the survey. The balance of 179 of the total 949 questionnaires sent out were made up of smaller batch manufacturing and design consultancy companies, for which there was no SIC code, and to have a wider distribution of company size and type in order to get an overall picture of task sharing in the U.K. The sample was later subjected to stratification and reported in chapter nine.

From a total of 949 questionnaires posted the number of replies received totalled 218, making a response rate of approximately 22%, of which 194 replies were useable. The response rates of the sample are taken from table 10 and replicated in table 11.

The summary data presented in table 11 provides a means of checking the distribution of industry sectors, product market data and R&D spending variables in the U.K. for the purpose of sub group

comparisons. However, due to the already complex nature of this work, it was decided not to pursue these analyses here but to deal with some of them in chapter nine for researchers interested in this area of study and they are raised again in the suggestions for future research (chapter 12).

			Population	Respondents	Overlap Groups
	Industry Sector	**SIC**	**%**	**%**	
1.	Software Design	72.2	13%	20.1%	
2.	Hardware	30.02	12%	38.1%	10% and 28.1%
3.	Scientific Instrumentation	33.20/2	7%	5.7%	
4.	Industrial Instrumentation	33.3 33.1	48%	6.2%	
5.	Components Manufacture	32.1	20%	6.2%	
6.	Other	*		14.9%	
	Summed Total		100%	100%	

Table 11: Comparison of Sample Response Rate to Total Population

By comparing the percentage of the respondent replies to the percentage of the total population for each industry sector, one is able to get an idea of the representativeness of the sample being analysed, particularly when considering stratification. Stratification is widely used in both random and non random sampling methods. It is therefore important to have good representation of the strata being selected. Samples can be stratified either by uniform sampling fraction (proportionate), or by variable sampling fraction (optimal or disproportionate). The response rates for software design and hardware show a strong representation of the sample. As in the pilot study there was some overlap between classes and great care was needed when coding responses in order to reflect, as closely as possible, the industry sector to which it truly belongs. As stated in the last two chapters SIC code 30.02 states that it is 'Manufacture of Computers and other processing equipment'. The questionnaire identified this item as 'Hardware' and includes power supplies, process controllers and ancillary computer accessories such as printers, tape drives and servo systems. The approximate overlap response rate split (see table 11 above) between software/computer related hardware devices and other types of hardware is 26/74. Thus the response for software related devices account for 10% and other hardware devices account for 28.1% of the total response (total 38.1%). The response rate spread is not uniform with industrial instrumentation and components manufacture not as well represented as other categories. Nevertheless, the response rate from several sectors could be considered representative of the total population. Thus for stratification purposes software design, hardware and scientific instrumentation, which comprise medium to high technology equipment, are all well represented.

8.5 Summary Statistics of U.K. Company Data

One common method used to analyse the respondent companies is by company turnover. The summary statistics for the respondent companies are given in Table 12, from which one can see that the types of companies are classified by turnover intervals.

	SALES	
Based on 1992/1993 Data	**COUNT**	**%**
1= <£1m	5	2.6%
2= £1-4.9m	49	25.3%
3= £5-9.9m	34	17.5%
4= £10-19.9m	31	16.0%
5= £20-49.9m	29	14.9%
6= >£50m	46	23.7%
Summed Total	194	100%

Table 12: Sample U.K. Company Turnover

The summary statistics given in table 12 show an approximate 60/40 split. 40%, or 75 of the respondent companies have a sales turnover in excess of £20 million per annum. It is useful to know that when stratifying by 'size' the sample remains reasonably representative.

Finally, a summary statistic table is provided giving the product market variables and R&D spending for the whole U.K. sample

Variable	Mean	Minimum	Maximum	N. Cases
SALES (approx.)	£9.35m	<£1.0m	>£50m	194.0
PLC (months)	76.40	6.0	600.0	169.0
MGROWTH (%)	19.66	10.0	250.0	166.0
MSHARE (%)	29.89	1.0	100.0	168.0
RDSPEND (%)	10.04	1.0	100.0	180.0

Table 13: Summary Data of Product Market and R&D Spending Variables in the U.K. sample

The mean value of company size is over £9m, well in excess of the minimum criterion set of £5m/annum. The other data could be useful information to have for further stratification, but is beyond the scope of this research.

8.6 Analysis and Findings of the Main Study Questionnaire

To investigate further the construct of 'strategic' and 'operational' autonomy, this next section of the research presents an analysis of content together with a correspondence of the main U.K. sample of

194 cases. When this analysis is combined with the result of the pilot study reported earlier, it is possible to draw some more definitive conclusions concerning how 'strategic' and 'operational' autonomy is currently shared with the team leader in U.K. manufacturing companies.

8.7 Methods of Team Leader Selection

A frequency table showing the responsibility for the selection of the team leader is given in table 14:

	Frequency	Percent	Valid Percent	Cum Percent
Steering Committee	21	10.8	10.8	10.8
Senior Manager	157	80.9	80.9	91.8
Team Leader (Self Selection)	8	4.1	4.1	95.9
Other (Various)	8	4.1	4.1	100.0
	-------	-------	-------	
Total	194	100.0	100.0	

Table 14: Responsibility for Selecting Team Leader

As may be seen from table 14 the predominant responsibility for selecting the team leader in the sample rests with the senior manager. Of the 194 companies surveyed only 8 used a self selection method. Since senior management in approximately 80% of the cases selected the team leader it was not considered useful to attempt any further analysis using sub groups as a means of comparison.

8.8 Selection Method

The method of team leader selection was a multiple choice question, the results of which are given in the following table:

METHOD		Frequency
1	Interview by Committee	37
2	Psychometric Tests	17
3	Personal Recommendation	105
4	Other (Various)	72

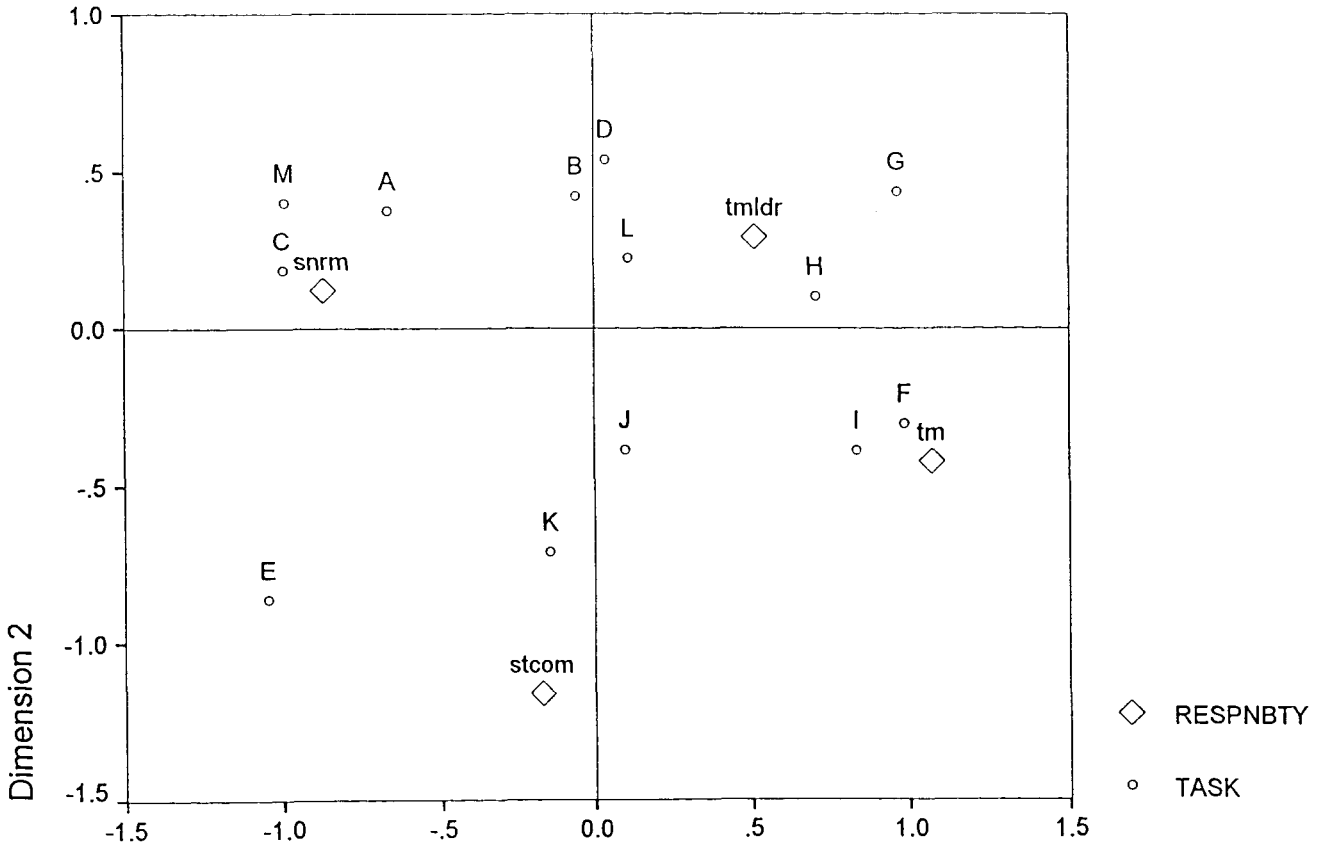
Table 15: Selection Method for Team Leader

In general, the preferred method of selecting the team leader was by personal recommendation, often backed up by a consistent track record. Once again, since only one method - method 3 - predominates, no further analysis of sub group comparisons is considered useful.

8.9 Overall Solution of Task Autonomy U.K. - 194 Cases

Figure 7 produced on page 105 shows a chart of the task/responsibility associations that exist for the sample in the U.K. (ANACOR data may be found in appendix E, pages 168-172). The similarities with the results of the Pilot Study are very striking. If one superimposes figure 7 (page 105) on figure 6 (page 93), the task/responsibilities distributions are almost identical except in relation to team de-selection and budget spending (B, D). These two tasks appear to be shared more with team leaders than was the case in the pilot study and will need to be analysed further. Given that the main study consisted of 194 cases it demonstrates the robustness of the pilot study. It may therefore be confidently asserted that, in general, the overall solution for the U.K. electrical/electronics manufacturers and control systems design companies is probably as represented in either of the two charts, with most of the 'strategic' task variables being located around senior management, particularly in respect of planning aspects A (team selection), B (budget setting) and M (rewarding team success).

Task/Responsibility Associations



Canonical normalization

Figure 7: U.K. Overall Sample, MAINSTUDY

Stakeholders

(snrm) Senior Management)
(stcom) Steering Committee
(tmldr) Team Leader
(tm) Team

Strategic Variables

(A) Team Selection
(B) Team De-Selection
(C) Budget Setting
(D) Budget Spending
(E) Project Selection Criteria
(M) Rewarding Team Success

Operational Variables

(F) Project Design
(G) Project Planning
(H) Project Scheduling
(I) Project Implementation
(J) Project Reviews
(K) Project Evaluation
(L) Project Deadlines

8.10 Discussion

Very little empirical attention has been given to autonomy in designing organisations or task groups to enhance managerial efficiency in NPD and yet it is clear from the evidence of the literature discussed in chapter two that one means of achieving project efficiencies is by more delegation of autonomy to the team leader. 'Although annual research transactions of large business firms (both here) and in the U.S. comprise expenditures of millions of dollars, the management of the research function to increase research productivity has received little scrutiny' (Hair, Anderson, Tatham and Black, 1995, p.416).

The main study has served to confirm the associations of 'strategic' and 'operational' tasks respectively with senior management and team leaders in electrical/electronics manufacturers and control systems design companies. Correspondence analysis was the first type of analysis used to confirm the overall association between tasks and responsibility. Correspondence analysis is an important first step to analyse the association of the two sets of variables. An analysis of U.K. data produced task responsibility positions similar to the pilot study confirming that, in general, whilst main responsibility for 'strategic' tasks resides with top management, operational task responsibilities are more associated or shared with the team leader.

Figures 6 and 7 reveal there to be small differences in some task locations. In the U.K. overall sample, task E (Project Selection Criteria) is more closely associated with the steering committee in the pilot study than in the main study. Whilst it is recognised that the steering, or executive committee usually comprises senior managers, it is typically a consensus decision making process involving input from other experts rather than an individual responsibility. Also, the positions of B (team de-selection) and D (budget spending) appear to be closer to the team leader, which need to be explained. Two possibilities are (a) the effect of technology and (b) the effect of company size. Both are investigated in the supplementary findings of chapter nine. Chapter nine investigates the effect that technology and company size appear to have on the distribution of task sharing among the four stakeholders.

8.11 Summary of Chapter

Summary data of the U.K. sample has been given and the overall solution of task autonomy for U.K. electrical/electronics manufacturers and control systems design companies is given. The association of 'strategic' and 'operational' tasks is confirmed by correspondence analysis in the main questionnaire study and indicates a broad agreement of the findings in the pilot study. Most of the strategic task autonomy resides with management whilst day to day operational tasks are delegated to the team leader.

Chapter 9 Supplementary Findings

9.1 Introduction to Chapter

One of the steps in sample design is concerned with the stratification or division of the population to be surveyed into groups with characteristics that have been identified as relevant to the needs of the particular survey (Chisnall, 1973, p.110). As the term stratification suggests, the researcher selects a quota or proportion of companies from each stratum in which he/she wishes to survey. If the objective of the survey is, say, to compare the distribution of project task responsibilities among medium to low, medium to high technology companies, and between similar strata of two countries, lists could be drawn up (using perhaps the number of employees, company size or technology used) and a quota of a representative proportion selected. This section will examine a number of supplementary findings which compare the stratification of the U.K. sample by technology and company size in terms of sales per annum. We shall also discuss a comparison between U.K. technology stratified data and the data from a similar group of companies in the United States - the software and electronics sector - in order that we may compare the practice of task sharing in both countries. The purpose of these analyses is to be able to generalize on the findings.

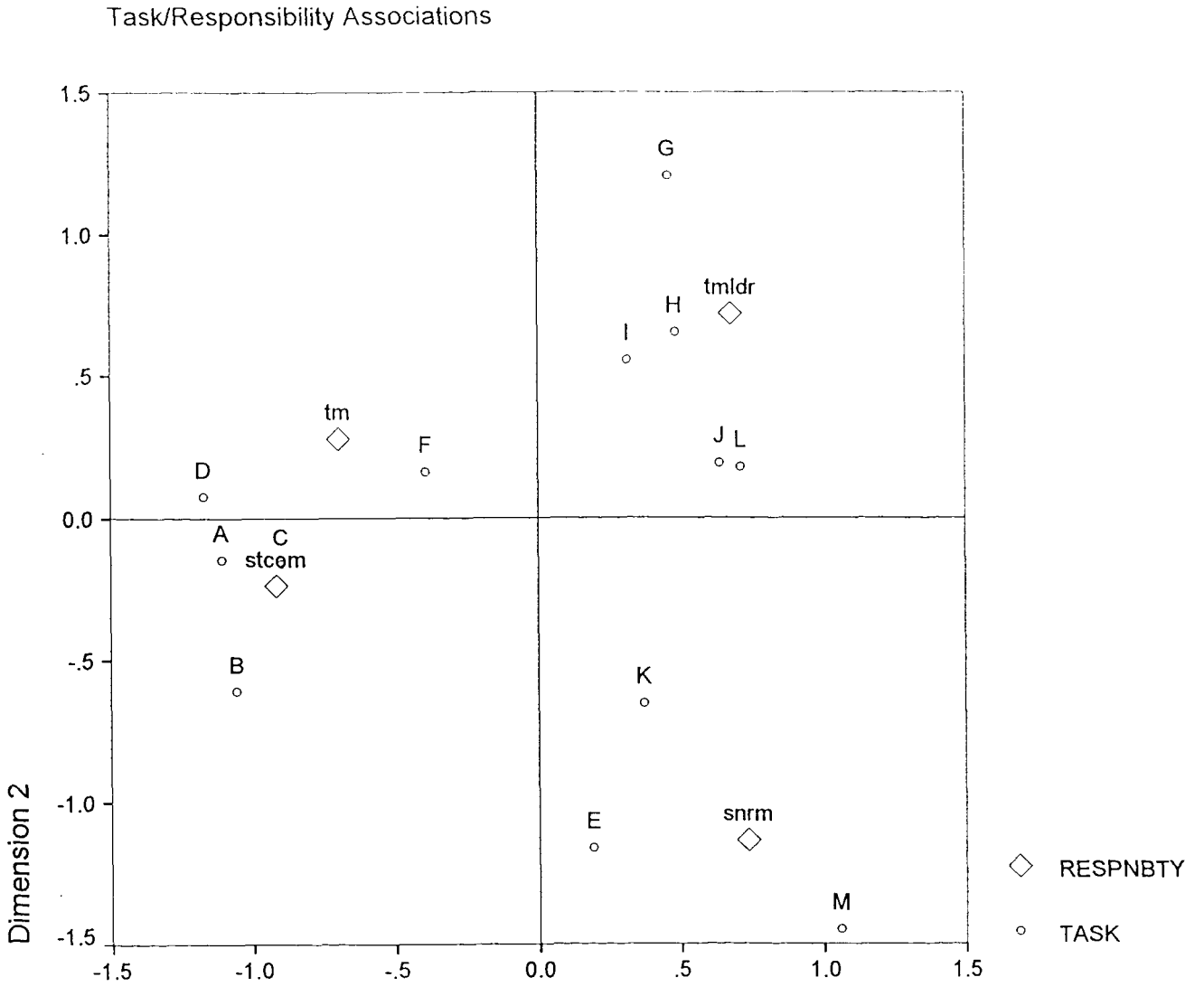
9.2 Medium to Low Technology Companies - 97 Cases

The U.K. sample was stratified into medium to low technology companies in order to determine whether technology has an influence on team leader task autonomy. Figure 8 on page 108 shows a chart of task responsibility associations for medium to low technology companies which indicates that management shares none of the strategic autonomy with the team leader.

The positions of all strategic type tasks are located close to either senior management or the steering committee. Indeed in this sample the steering committee also appears to be mainly responsible for the tasks of team selection, team de-selection, budget setting and budget spending (A, B, C, D). On this evidence it appears that management in medium to low technology companies does not tend to share 'strategic' tasks and appear to be 'top-down' in management style. A comparison with the overall U.K. sample represented by figure 7 in chapter 8.9 (page 105) would thus indicate that technology might be an important determinant of team leader autonomy.

9.3 Electrical/Electronics/Software Companies - 133 Cases

This stratified sample was used for the purpose of comparison with the overall U.K. sample, the medium to low technology companies and the U.S. sample. The data solely from electrical/electronics technology companies and software design, may be seen in figure 9 on page 109.



Canonical normalization

Figure 8: U.K. Medium/Low Tech Co's, MAIN STUDY

Stakeholders

(snrm) Senior Management)
(stcom) Steering Committee
(tmldr) Team Leader
(tm) Team

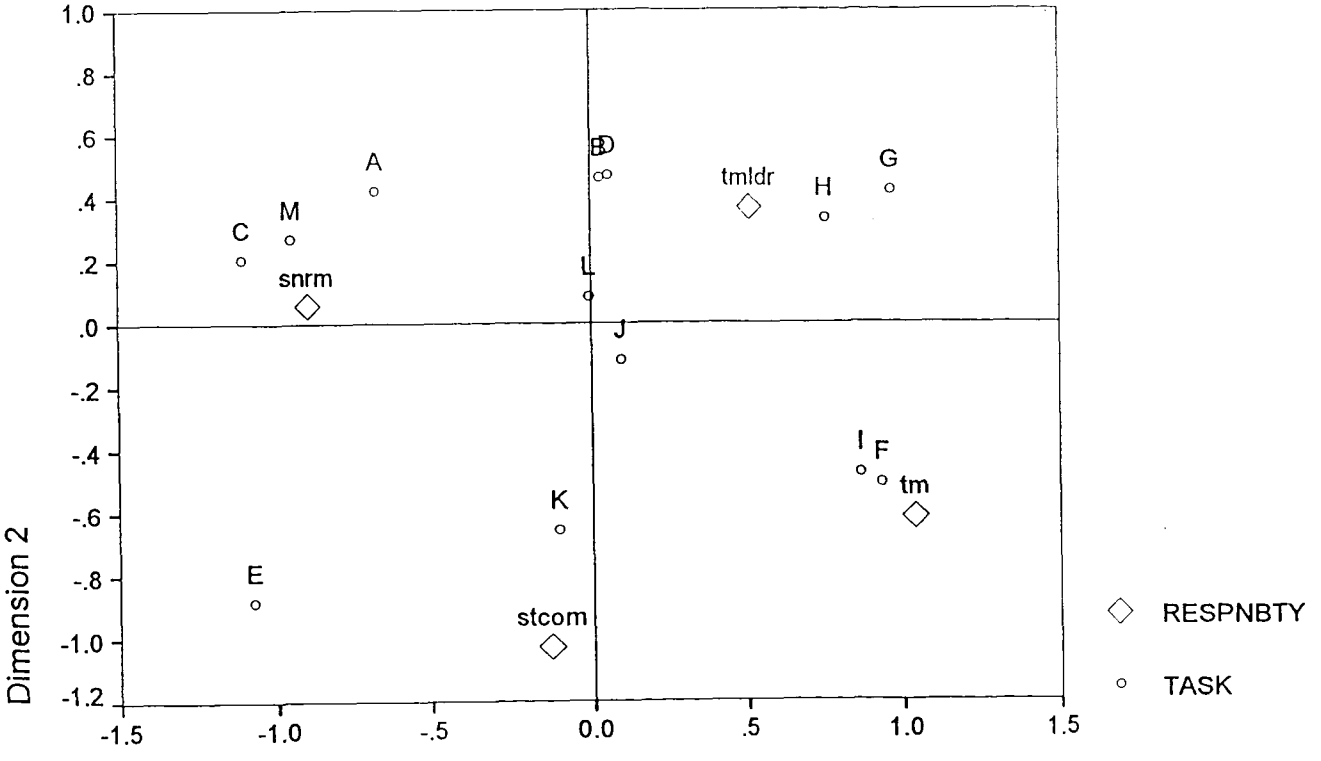
Strategic Variables

(A) Team Selection
(B) Team De-Selection
(C) Budget Setting
(D) Budget Spending
(E) Project Selection Criteria
(M) Rewarding Team Success

Operational Variables

(F) Project Design
(G) Project Planning
(H) Project Scheduling
(I) Project Implementation
(J) Project Reviews
(K) Project Evaluation
(L) Project Deadlines

Task/Responsibility Associations



Dimension 1

Canonical normalization

Figure 9: Electrical/Electronics/Software Co's, MAIN STUDY

Stakeholders

(snrm) Senior Management)

(stcom) Steering Committee

(tmldr) Team Leader

(tm) Team

Strategic Variables

(A) Team Selection

(B) Team De-Selection

(C) Budget Setting

(D) Budget Spending

(E) Project Selection Criteria

(M) Rewarding Team Success

Operational Variables

(F) Project Design

(G) Project Planning

(H) Project Scheduling

(I) Project Implementation

(J) Project Reviews

(K) Project Evaluation

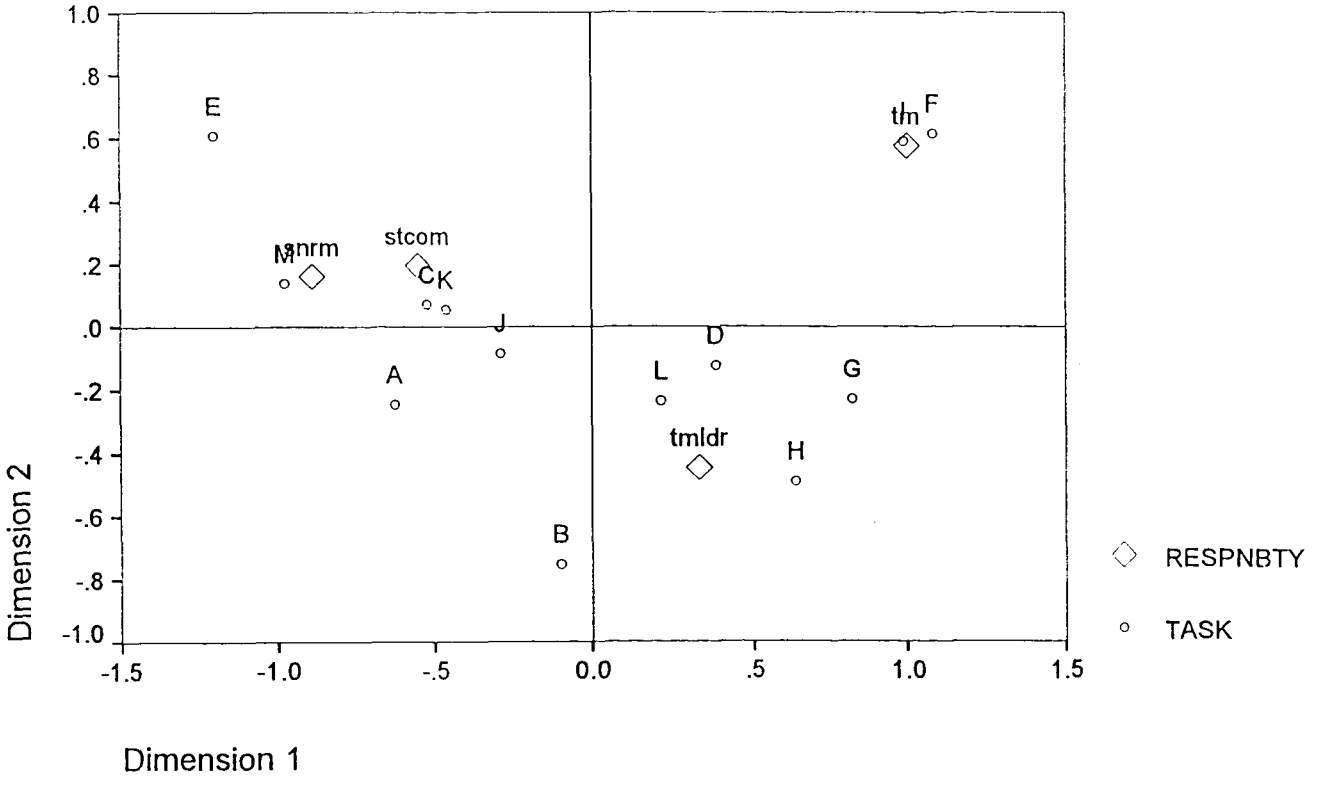
(L) Project Deadlines

Figure 9 shows very little difference in task distribution to the overall U.K. sample (figure 7). However, there is a closer proximity of tasks for team de-selection (B) and budget spending (D) to the team leader but otherwise there is great similarity of sharing of other tasks by management. Given the findings in Figures 7, 8 and 9, it would appear that technology could be a major determinant in task delegation.

9.4 Overall Solution of Task Autonomy U.S.A. - 71 Cases

Figure 10 shown on page 111 shows the task/responsibility associations which exist in the U.S. sample of 71 companies. This sample was taken from the members of the American Electronics Association (AEA) with employees in excess of 130 and constitutes a reasonably homogenous sample. Figure 10 may be directly compared with Figure 9 (page 109) of the Electrical/Electronics and Software companies in the U.K., since it is constructed from a similar mix of companies. Many of the task locations are similarly associated as in the equivalent U.K. sample but there appears to be a clear delegation of the 'budget spending' (D) task to the team leader, which is not the case in the U.K. equivalent sample. Also, there is a significant difference relating to the tasks shared with the steering (or representative) committee in the U.S. to that of the U.K. In the U.S. the steering committee very closely shares decisions on four of the 'strategic' tasks with senior management: Team Selection, Budget Setting, Project Selection Criteria, and Rewarding Team Success (A, C, E, M). In the U.K. it is only in the area of project selection criteria that the steering committee is primarily responsible. This suggests that in the U.S. the steering committee is more involved in 'strategic' task decisions more than their counterparts in the U.K.

Task/Responsibility Associations



Canonical normalization

Figure 10: U.S. Sample, MAIN STUDY

Stakeholders

(snrm) Senior Management)

(stcom) Steering Committee

(tmldr) Team Leader

(tm) Team

Strategic Variables

(A) Team Selection

(B) Team De-Selection

(C) Budget Setting

(D) Budget Spending

(E) Project Selection Criteria

(M) Rewarding Team Success

Operational Variables

(F) Project Design

(G) Project Planning

(H) Project Scheduling

(I) Project Implementation

(J) Project Reviews

(K) Project Evaluation

(L) Project Deadlines

9.5 Comparing Data between the U.K. and U.S.A. based on Demographics

Before deciding on whether to conduct an analysis of the U.K. and U.S. data from similar industries, we first inspect the comparison of demographic and R&D Spending variables of both countries to see whether the two main sets of data might be combined into one data set. To do this a simple 't' test was performed on the following variables:

Yearly Sales	- SALES
PLC (Product Life Cycle)	- PLC
Market Growth Rate	- MGROWTH
Market Share	- MSHARE
R&D Spending on NPD (New Product Development)	- RDSPEND

For deciding whether the two sets of data have similar means a Levene test was used to determine whether the pooled variance or separate variance estimate should be accepted. It was necessary to decide on the significance level acceptable for evaluating if data sets have similar means. In common with research criteria the 5% level was chosen.

			Pooled Variance Estimate			Separate Variance Estimate		
Variables	Levene Test F Value	p value	t Value	Degrees of Freedom	2-tail Sig	t Value	Degrees of Freedom	2-tail Sig
SALES	16.128	.000				-4.87	201	.000
PLC	0.025	.876	0.36	189	.720			
MGROWTH	6.937	.009				1.65	182.93	.100
MSHARE	.895	.345	-2.83	189	.005			
RDSPEND	1.312	.253	-.80	193	.425			

Table 16: Simple 't' test on U.K. and U.S. Demographic Variables

From table 16 it may be seen that Product Life Cycle, Market Growth, and R&D Spending are not significant, indicating that these data could be combined provided one is using these variables as a comparison. The full details are given in appendix F, pages 173-175. The 't' test of Sales and Market Share between the U.K. and U.S.A. were significant and therefore do not have similar means. Since it makes little sense to analyse only parts of a combined sample it was decided to discontinue this line of investigation, although of course this could be the subject of future research. However, it would be meaningful to compare similar company types for degrees of task delegation. To this end the summary statistics for the U.K. stratified sample together with the sample of U.S. companies is given in Table 17.

	U.K. Electrical/Electronics /Software Companies Average Data	U.S.A. Electrical/Electronics /Software Companies Average Data
Sales	£18m	£29m
PLC	4.5 years	4.5 years
Market Growth	23%	16%
Market Share	27%	36%
R&D Spending	10%	11%

Table 17: Summary Statistics for Similar Company Types

Although the average company size was different, on average the product life cycle and the amount spent on R&D are similar, thus it was felt that a useful comparison of the two groups could be made. Comparisons were made using correspondence analysis and will now be discussed in more detail.

9.6 U.K. Electronics/Software Companies less/greater than £20m/annum

Figures 8 and 9 on pages 108/109 are evidence to suggest that the type of industry in which a company operates might be a key determinant of team leader autonomy. This being the case, by extension, it is possible that company size might also be a determinant of team leader autonomy. In order to test this hypothesis the sample was further stratified by sales per annum. Figure 11, on page 114, shows only the distribution of 'strategic' tasks versus responsibility for companies with less than £20m (A, B, C, D, E, M), and over £20m (A1, B1, C1, D1, E1, M1) turnover per annum, due to chart overcrowding.

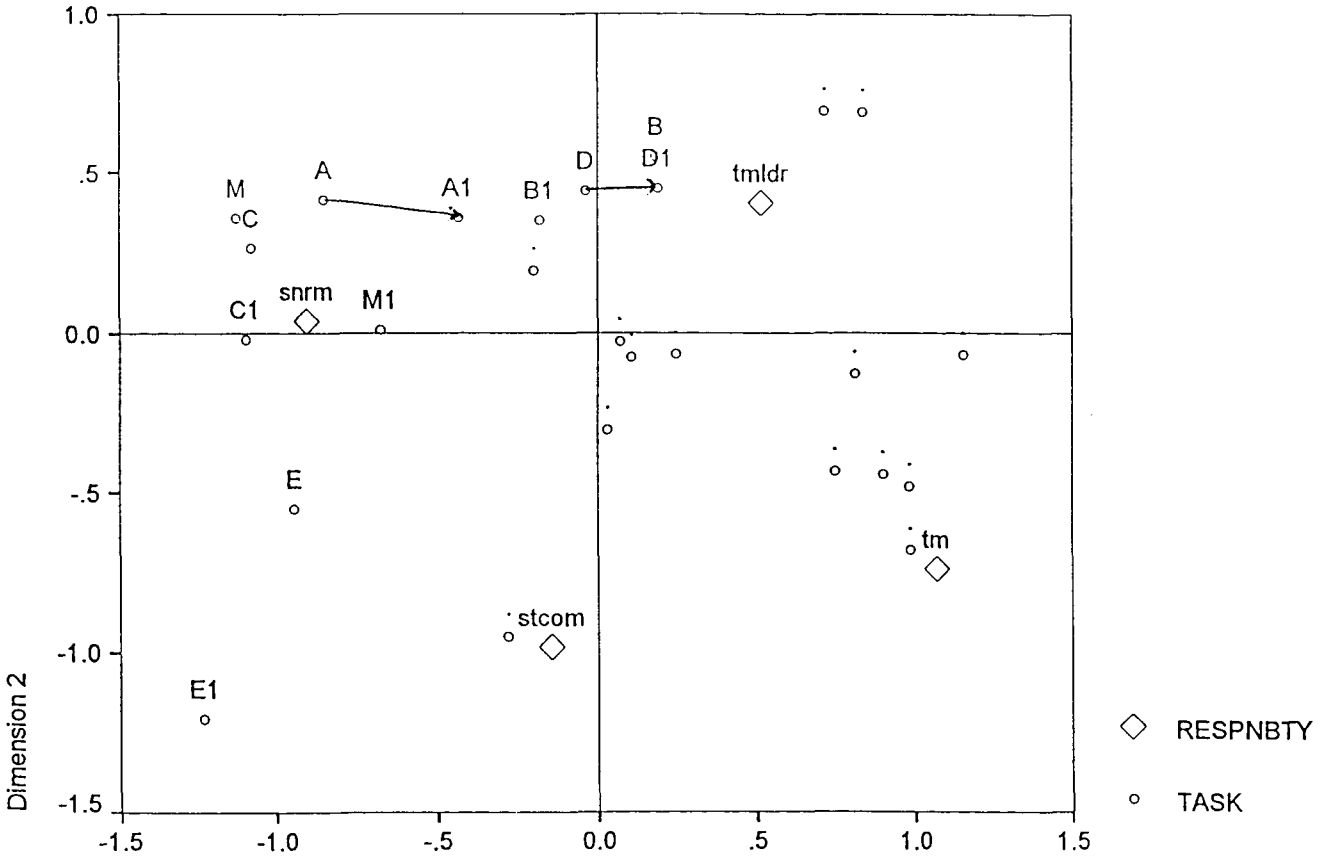
There seems to be a significant difference between the task location positions when they are considered in terms of sales revenue. The responsibility for team selection and budget spending appears to be shared with the team leader to a higher degree than in the stratified sample, figure 9, p109 . Figure 11, (page 114) shows the movement of locations A $\Rightarrow$ A1 (team selection) and D $\Rightarrow$ D1 (budget spending) which indicate that these tasks are more closely associated, and therefore shared, with the team leader than in any of the previous cases. In this sample of companies based on sales per annum it appears that sales may well be a determinant of team leader autonomy. These movements need to be explained.

9.7 U.S. Companies less/greater than £20m/annum

An inspection of the U.S.A. sample stratified by company size in figure 12, page 115, shows the distribution of task versus responsibility for companies with less than £20m (A, B, C, D, E, M), and over £20m (A1, B1, C1, D1, E1, M1) turnover per annum. As was the case in the equivalent U.K.

Task/Responsibility Associations for Companies

<£20M and >£20M/annum



Canonical normalization

Figure 11: U.K. Electrical/Electronics/Software Companies

Stakeholders

(snrm) Senior Management)

(stcom) Steering Committee

(tmldr) Team Leader

(tm) Team

Strategic Variables

(A) Team Selection

(B) Team De-Selection

(C) Budget Setting

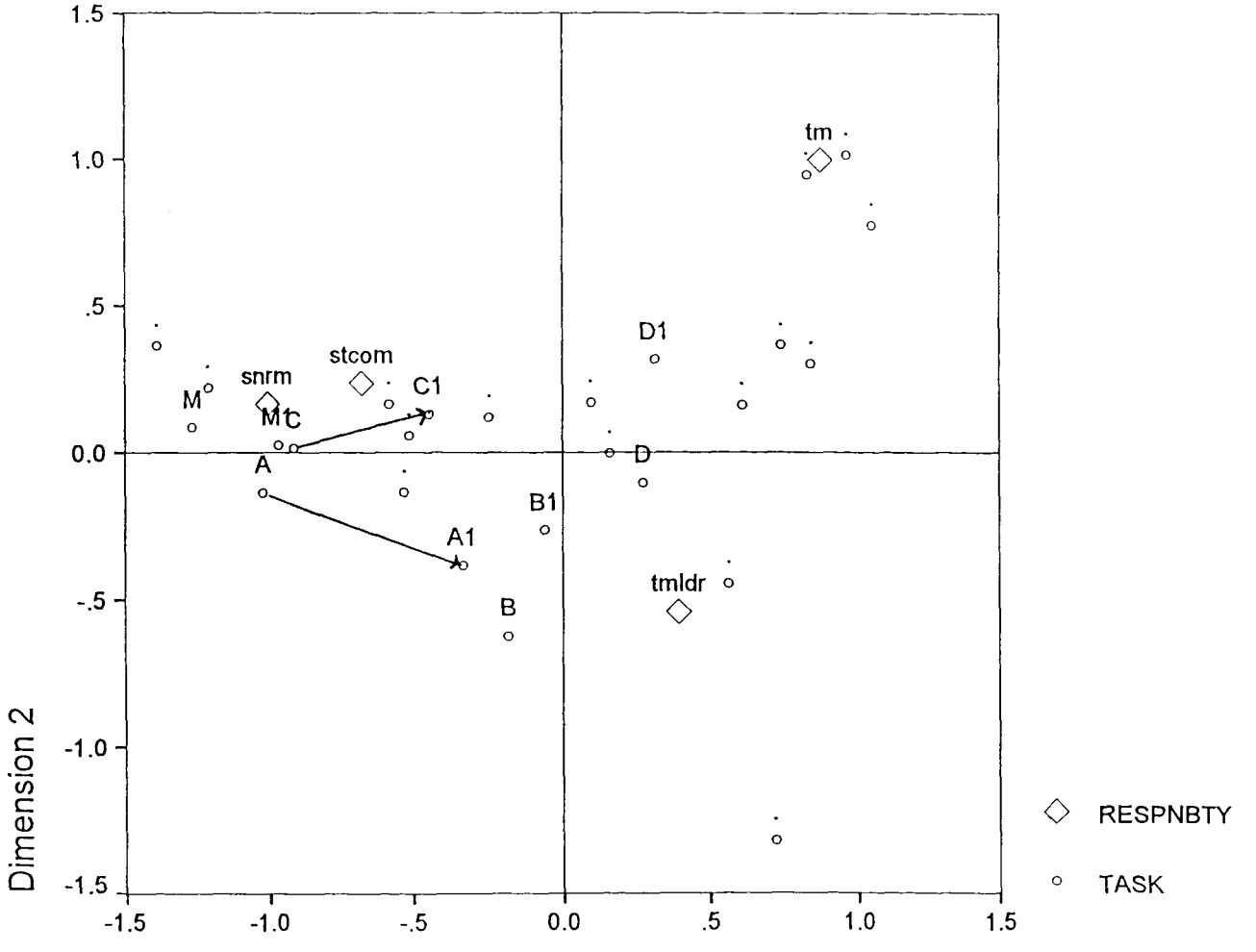
(D) Budget Spending

(E) Project Selection Criteria

(M) Rewarding Team Success

Task/Responsibility Associations for Companies

<$40m (£20m) and >$40m (£20m)/annum



Canonical normalization

Figure 12: U.S.A. Companies, MAIN STUDY

Stakeholders

(snrm) Senior Management)

(stcom) Steering Committee

(tmldr) Team Leader

(tm) Team

Strategic Variables

(A) Team Selection

(B) Team De-Selection

(C) Budget Setting

(D) Budget Spending

(E) Project Selection Criteria

(M) Rewarding Team Success

sample there appears to be a significant difference between the task locations when they are considered in terms of sales revenue. The responsibility for team selection and budget setting appears to be shared with the team leader to a higher degree than in figure 10, page 111. Figure 12 (page 115) shows the movement of locations A ⇒ A1 (team selection) and C ⇒ C1 (budget setting) which indicate that these tasks are more closely associated, and therefore shared, with the team leader than in the overall U.S. data in figure 10. In this sample of companies based on the sales per annum, as in the equivalent U.K. data, it appears that sales may well be a determinant of team leader autonomy.

9.8 Other Determinants of Team Leader Autonomy

If sales is a determinant of the degree of team leader autonomy, it may also apply to other variables, for example, the internal variable of R&D spending. In order to pursue this a little further tests using spearman rank correlations and multiple regressions on the U.K. stratified sample were applied between sales, R&D spending and the data obtained from question 8, dealing with the degree of autonomy granted to team leaders for a range of tasks variables, and may be found in appendix G, pages 176-180. These indicate that a relationship, albeit a non linear relationship, appears to exist and may need to be researched further.

9.9 Summary of Chapter

A comparison was made between the data of U.K. medium to low technology and medium to high technology companies indicating that technology could be a determinant of team leader autonomy. The survey sample of the U.S.A. has been examined and shows that the steering committee is more involved in strategic type tasks than their U.K. counterparts. The U.K. Electrical/Electronics/Software sample and the main study U.S. data was stratified by company size and appears to indicate that company size could be a determinant of team leader autonomy. Other possible determinants of team leader autonomy are discussed.

Chapter 10 Supplementary Findings - Autonomy Maps and Underlying Dimensions of Project Issues.

10.1 Introduction to Chapter

Question 8 addressed two issues as discussed in chapter 8.3: (a) facilitate a measurement of the degree of both 'strategic' and 'operational' autonomy given to team leaders as described by Bailyn (1985), and (b) define managers' perception of project issues. In addition to constructing a 'map' the same data may be used to elicit and describe management's perception of underlying factors in project management. The use of factor analysis provides a technique for better understanding the complexity of project issues.

10.2 Autonomy 'Maps'

Another of the objectives of this research was to attempt to add to the work by Bailyn (1985) in the construction of an autonomy map and was discussed in chapter 3.5. Bailyn's map (chapter 3, figure 3) was constructed through the use of employee self reports. It has been stated in chapter 1.3 that there is some disagreement about whether variables, such as autonomy, should be assessed via employee self reports. This work does not seek employee perceptions of their position in the company, since the researcher is interested in assessing management's perception of strategic/operational autonomy of individuals and it seems feasible that management is best placed to provide the specific information required. With this information it is possible to provide an aggregate position for the top management's determination of team leader 'strategic'/'operational' autonomy. As described in chapter 3.5 the 'autonomy' map may be used by management in the annual appraisal/assessment of the team leader and could be considered an important part of the training process for an employee's continuous development. Figure 13 (p.118) represent management's overall view of where this key employee is positioned on the map. The following team leader autonomy maps were constructed for the U.K. and U.S.A. by aggregating the interval Likert data from question 8. The average A was achieved by taking the sum of each task variable in question 8 and applying the following simple averaging calculation:

$A_i = 9(\Sigma Q8v/194)/7$, where v=each variable A-M. Each group, 'strategic' and 'operational' average is then added together and divided by the respective number of components in order to form a further average as follows: 'strategic' average= A(A, B, C, D, E, M)/6 and 'operational' average= A(F, G, H, I, J, K, L)/7. Both averages were then plotted on the 'X' and 'Y' scales respectively.

As may be seen from figure 13, for both countries the average team leader autonomy lies to the left of the 45 degree line, with the U.S. ranking slightly higher in 'strategic' autonomy.

The following were the average scores:	U.K.	U.S.A.
Strategic Autonomy	4.07	4.3
Operational Autonomy	5.14	5.1

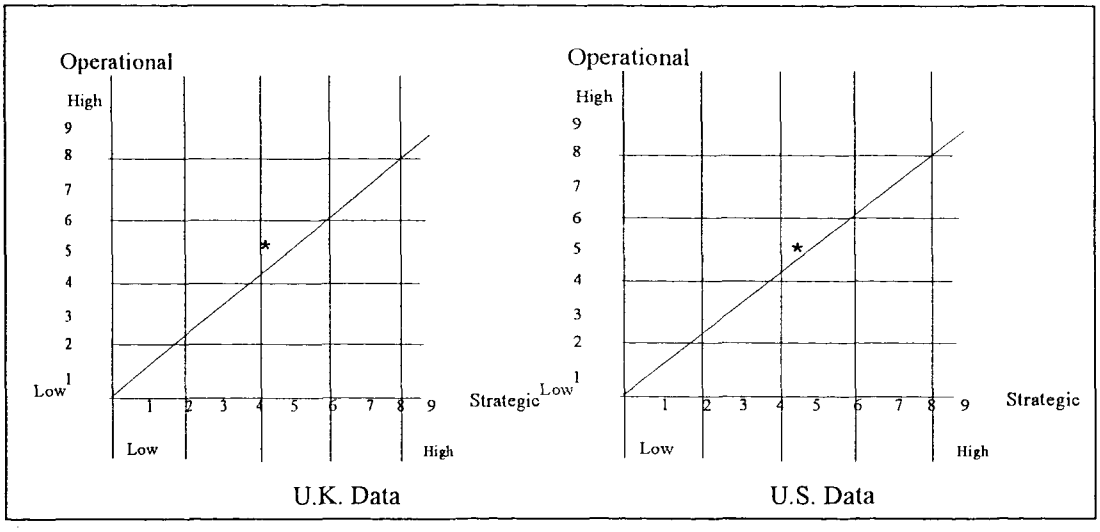


Figure 13: Autonomy Maps for the U.K. and U.S.A.

Using the averaging technique for Likert scale data mentioned above, an autonomy map was constructed for both the U.K. and U.S. sample of companies which showed very similar average map positions for team leaders except that the U.S. average for 'strategic' autonomy is 13% higher. Perhaps, unsurprisingly, the two sets of country data reveal similar map positions because they come from very similar company types. It is anticipated that further stratification by, say, seniority of the team leader, could yield greater position differences but this would be the subject of further research.

10.3 Factor Analysis of the Task Variables

One area of interest to researchers might be the underlying dimensions in project management. Factor analysis can be utilised to examine underlying patterns or relationships for a large number of variables in order to determine if the information can be condensed or summarised into a smaller set of factors or components (Hair, Anderson, Tatham and Black, 1995, p.233). Characteristics which relate to each other constitute a factor and factor analysis refers to a number of related statistical techniques which help to determine them.

These techniques are used for three main purposes. First, they can assess the degree to which items are connected with the same concept. In this work for example, if managers respond in different ways to questions about design issues and budgets, it suggests that these feelings can be distinguished. In other words, factor analysis enables us to assess the factorial validity of the questions which make up the scales by telling us the extent to which they seem to be measuring the same concepts or variables

(Bryman and Cramer, 1990, p.254). Second, for a large number of variables factor analysis can determine the degree to which they can be reduced to a smaller set. Thirdly, factor analysis has been used to limit the number of factors which make up complex and social behaviour.

R&D managers were asked in question 8 to rate, on a seven point Likert scale, the extent to which each task was the autonomous responsibility of the team leader in order to determine management's perception of the factors relating to 13 task variables in project management. New research information of this nature can be thought of as a means of identifying distinct phases of the project that top management may or may not wish to delegate to the team leader. This was achieved by asking questionnaire respondents to rate all of the 13 task variables, discussed in chapter 3.6, (p.49) on a scale of 1-7 (very low - very high). The question said, 'On a scale of 1-7 what degree of autonomy would you say the team leader has?'

10.4 Reliability of Data used for Analysis

In order to assess the reliability of data used for the factor analyses of both the U.K. and U.S., the data were subjected to a coefficient of alpha test, the KMO (Kaiser-Meyer-Olkin) measure of sampling adequacy and the Bartlett test of sphericity. Cronbach alpha scores tend to rise when larger samples with numerous variables are tested, thus care should be exercised when using the data. Nevertheless, the alpha score on 194 cases was in excess of 0.8 and tests on sub groups of data to be analysed gave the following alpha scores:

RELIABILITY ANALYSIS - SCALE (ALPHA) and KMO TEST

Reliability Coefficients	Business Group	Nr Cases	Alpha	KMO
Based on:	Overall Solution	194	.8208	.82911
	Manufacturing companies	165	.8322	.81988
	Med/Low tech companies	97	.7759	.72991
	Electrical/Electronics/ Software Companies	133	.8496	.83488
	U.S. companies	71	.8199	.74606

Table 18: Cronbach Alpha, and KMO Scores

The KMO (Kaiser-Meyer-Olkin) measure of sampling adequacy is an index for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. The closer to '1' the better. The Bartlett test of sphericity tests that the correlation matrix is an identity matrix, i.e. all the diagonal terms are 1 and all off-diagonal terms are 0. The value should be high and the significance level very small. Table 18 provides scores for Cronbach Alpha and KMO only.

10.5 Assessing the Number of Factors to be used.

The method of determining the number of factors to represent the data is the latent root criteria (or eigenvalues) which are assessed close to the value of '1'. Taking into account the point at which the eigenvalue is close to 1 it may readily be seen that a 4 factor solution is also appropriate and the cumulative percentage of variance is 62.7%, an acceptable level.

Final Statistics					
Variable	Communality	Factor	Eigenvalue	Pct of Var	Cum Pct
Q8A	.75831	1	4.72591	36.4	36.4
Q8B	.72960	2	1.28500	9.9	46.2
Q8C	.62041	3	1.18083	9.1	55.3
Q8D	.64919	4	.95899	7.4	62.7
Q8E	.66701				
Q8F	.70432				
Q8G	.73049				
Q8H	.58884				
Q8I	.61668				
Q8J	.51707				
Q8K	.58979				
Q8L	.42880				
Q8M	.55021				

Table 19: Final statistics of the Principal Components Analysis of U.K. data

Another method of determining the number of factors to be used is that proposed by Cattell (1966) known as the scree test and is characterized by having a gradual trailing off resembling the rubble that forms at the foot of a mountain. Experimental evidence indicates that the scree begins at the factor which is the true number of factors. From this scree plot it appears that a four factor model is appropriate for the U.K. sample.

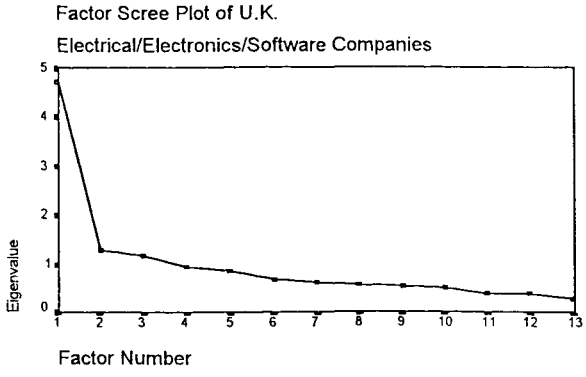


Figure 14: Scree Test for U.K. Sample

Yet another method of determining the number of factors to extract is by using the maximum likelihood method of extraction which provides a chi-square goodness of fit statistic. An indication of when the data is independent is at the point that the significance is greater than 0.05. For the U.K. data the chi-square significance is: 0.1641 which is given in Table 20

10.6 Factor Analysis on U.K. Stratified Data

A factor analysis was run separately on the task autonomy variables in the UK electrical/electronics and software companies sample using the Varimax and Oblimin methods of rotation with the result that both rotations revealed similar loadings.

The Oblimin solution is reported which provided a more robust set of factors shown below in Table 20.

OBLIMIN Principle Components Factor Analysis

Structure Matrix:

	Factor 1	Factor 2	Factor 3	Factor 4
	Proj. Scope	Team Issues	Proj Dev.Life Cyc.	Tactical
Team Selection		-.84583		
Team De-Selection		-.84869		
Reward Team Success-		-.63698		
Budget Setting	. 67455			
Budget Spending	. 62887			
Project Design	-.57231			
Project Planning			.76010	
Project Scheduling			.75085	
Project Implementation			. 74588	
Project Selection Criteria				.77686
Project Reviews				.66709
Project Evaluation				.72905
Project Deadlines				.51149
U.K. FIT ESTIMATE BY MLE, ELECTRICAL/ELECTRONICS/SOFTWARE GROUP Test of fit of the 4-factor model: **Chi-Square statistic: 39.7109, D.F.: 32, Significance: .1641**				

Table 20: Factor Analysis for UK Electrical/Electronics/Software Companies and Chi-Square for the Four Factor Model

The UK factor analysis produced four factors that have been interpreted as: 'Project Scope', 'Team Issues', 'Project Development Life Cycle' and 'Tactical Issues'. Table 20 presents the principle factor analysis and the maximum likelihood (ML) Chi-Square for the four factors of the U.K. data using the Oblimin method of rotation. The Chi-Square statistic may be considered as one method of confirmatory factor analysis and, as may be seen, the solution provides a Chi-Square which demonstrates the independence of the data indicating that a four factor model is appropriate. The interpretation is based on the significant higher loadings. The factor analysis produced well ordered variables mostly with high loadings (>0.5). The relative direction of loading can be important. For example for factor 1 we can see that it consists of two groups of variables which constitute the factor 'Project Scope', budget setting/spending both of which have a positive sign, and project design which has a negative sign. These two groups move in opposite directions to each other indicating that project design is inversely related to budget issues. One possible interpretation for this could be that

project cost might be an inverse function of design. However, this would need to be researched further.

The other three factors all have unidirectional signs (i.e. positive or negative) and these do not suggest any particular inter-variable interpretation. Thus two of the factors for the UK data suggest that top management perceives matters of project scope ('budget setting', 'budget spending' and 'project design') and project development life cycle ('project planning/scheduling/implementation') as underlying factors. The result suggests that in the U.K. managers in this industry sector perceive there to be an emphasis or importance placed on expense/cost control and the team tasks related to the Project Development Life cycle. Clearly, this is speculative and would need further research.

10.7 Assessing the Number of Factors to be used in the U.S. sample.

The same method of determining the number of factors to represent the data has been used as for U.K. stratified sample. The latent root criteria (or eigenvalues) are assessed close to the '1'. Taking into account the point at which the eigenvalue is close to 1 it may readily be seen that a 4 factor solution is also appropriate and the cumulative percentage of variance is 64.6%, an acceptable level.

Final Statistics					
Variable	Communality	Factor	Eigenvalue	Pct of Var	Cum Pct
Q8A	.62496	1	4.29812	33.1	33.1
Q8B	.63724	2	1.58481	12.2	45.3
Q8C	.65370	3	1.48465	11.4	56.7
Q8D	.65337	4	1.02428	7.9	64.6
Q8E	.47174				
Q8F	.78433				
Q8G	.75727				
Q8H	.65829				
Q8I	.69084				
Q8J	.66688				
Q8K	.58962				
Q8L	.47958				
Q8M	.72405				

Table 21: Final statistics of the U.S. Principal Components Analysis

Figure 15 shows a plot of the total variance associated with each factor in a scree plot. The break appears to be at the fourth factor indicating that four factors are sufficient for this sample

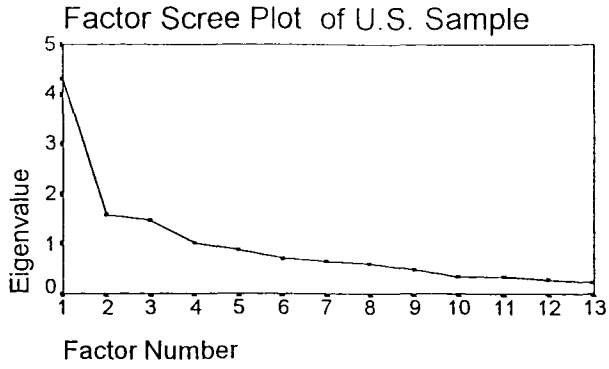


Figure 15: Scree Test for U.S. Sample

The method of determining the number of factors to extract may also be assessed by using the maximum likelihood method of extraction which provides a Chi-Square goodness of fit statistic. An indication of when the data is independent is at the point that the significance is greater than 0.05. The test of goodness of data fit using the maximum likelihood method of extraction produced a Chi-Square statistic with a significance of 0.2390 (see table 22, p.124), again indicating the appropriateness of a four factor model.

10.8 Factor Analysis on U.S. Data

Data relating to the U.S. came from a representative sample made up of U.S. electronics and software manufacturers. As with the 'stratified' U.K. sample of technology companies, the advantage of a more focused group of companies is that the factor analysis may be regarded as representative for that group. Whilst the sample was not as large as that of the U.K., it scores well on the KMO - Bartlett measure of sphericity and considered sufficiently large to make a meaningful factor analysis of the task autonomy ratings. Also, given the similarity of industries to the U.K. stratified sample a factor comparison was made.

OBLIMIN Principle Components Factor Analysis

Structure Matrix:

	Factor 1	Factor 2	Factor 3	Factor 4
	Proj. Planning	Team Issues	Proj Dev.Life Cyc.	Tactical
Team Selection			.77967	
Team De-Selection			.57931	
Reward Team Success-			.83121	
Budget Setting	.61914			
Budget Spending	.69775			
Project Planning	.83773			
Project Deadlines	.58220			
Project Design		-.87165		
Project Implementation		-.81413		
Project Selection Criteria				.50980
Project Scheduling				.72419
Project Reviews				.80764
Project Evaluation				.64593
U.S. FIT ESTIMATE BY MLE, ELECTRONICS/SOFTWARE GROUP Test of fit of the 4-factor model: **Chi-Square statistic: 3937.2821, D.F.: 32, Significance: .2390**				

Table 22: Factor Analysis for US Electronics/Software Companies and Chi-Square for the Four Factor Model

The factor analysis run on the U.S. data revealed some similarity of factors to the U.K. data, but differed in one subtle way. In addition to loading well on task variables C and D (budget setting and spending), the U.S. data for factor 1 also loaded well on task variables G and H (Project Planning and Scheduling), which was interpreted as a 'Planning' factor. A comparison of the U.K. and U.S. factors using LISREL was considered, but is impractical for two reasons: (i) an 'a priori' model would be required and (ii) the samples generally need at least 200 observations to be robust.

10.9 Summary of Chapter

The autonomy map has been described in chapter 3.5 and is regarded as a useful tool in the formal observation of an individual's exercise of responsibility in work tasks. Frequently, employee assessment or appraisal schemes in many companies are coupled with a continuous development programme in order to build upon skills. A factor analysis was performed on both U.K. stratified data and U.S. data which appears to confirm differences of emphasis between the two countries. This more powerful analytical technique suggests that there are subtle differences between the two sets of data.

Chapter 11 Discussion and Conclusions

11.1 Introduction to Chapter

This chapter reviews the different strands of the research and the manner in which it was conducted, including reference to the methods of data collection used. It will briefly discuss the main issues in the pilot study interview findings and the change in direction away from the study of intrapreneurs to team leader autonomy. This section will also discuss the implications the findings in the main study and the supplementary chapters have for previous research on autonomy.

11.2 Discussion

Initially, the research proposal was to investigate the role and degree of autonomy given to the intrapreneur against a background of new product development in a business environment and to investigate the mechanisms by which authority is delegated, but this was later changed in favour of investigating team leader autonomy. It became clear from the pilot interviews that the term 'Intrapreneur' was synonymous with the interviewees' perception of the project team leader and that, in future, the research should concentrate on him/her as the unit of analysis.

One of the major problems in achieving a higher output of new products, according to Bart (1993), is the tight control found in large corporations. One means of relaxing the controls on team leaders is to give them a greater degree of autonomy to control both strategic and operational tasks. Since change is becoming more frequent and dramatic for many organisations, managers responsible for developing new products need to move ideas forward that will help to create a new NPD working environment where tasks are more readily shared with the team leader than presently appears to be the case.

Projects are often rated as successful because they have come in on or near budget and schedule and achieved an acceptable level of performance. These characteristics may be used because they are the easiest to measure and they remain within the realm of the project organisation (Pinto and Slevin, 1988, p.67). In order to enhance the efficient use of resources it may be argued that team leaders should be allowed to operate in more flexible task environments. In his concluding remarks Thomason (1988) states that, in future, greater focus at the leading edge of human resource management will be:

> 'establishing flexibility in working and employment patterns to support the economically dictated operational needs, not only to meet the undertaking's strategic needs but also to provide a wider range of choice to workers'
>
> (Thomason, 1988, p.508)

This flexibility would allow team leaders a generous amount of freedom to participate extensively in product strategy decisions and human resource deployment, coupled with a high degree of accountability for demonstrating desired returns on product investment. 'Research on R&D teams suggests that the project (team) leader has a significant impact on project performance... For technology companies in particular, a high performing NPD effort is critical due to fast changing technologies and market needs, short product life cycles, and heightened global competition' (Barczak and Wilemon, 1992, p.61).

Decentralisation of authority was discussed in chapter three in terms of the degree of delegation of decision making authority throughout the organisation and the extent of participation by team leaders in decision making. Organisations could be regarded as a set of complex mechanisms for arriving at participative decision making through bargaining and influence processes amongst four stakeholders.

No previous research has specifically attempted to quantify team leader autonomy in NPD. Indeed, compared with other subjects such as technology, marketing and finance, little empirical research has been reported on what actually goes on in the human resource management area of new product development activities of the firm. The research reported in this thesis therefore concentrated on some of these issues.

Several different concepts and measurements of autonomy have been discussed in chapter three but in the research for this thesis autonomy has been subdivided into two dimensions, 'strategic' and 'operational'. These dimensions have been explained in the context of sharing the responsibility for tasks, and task variables were developed for these dimensions that have been validated within a range of research literature and by using grounded theory. These dimensions are an attempt to measure the flexibility that team leaders enjoy when handling a particular task (such as the implementation of a budget).

The results of this research demonstrated that, in electrical/electronics manufacturers and control systems design companies, top management tends to hold on to its power and does not delegate much strategic autonomy. Exploratory measures of correspondence analysis techniques used in this research indicated that a number of significant relationships exist confirming that senior management is mainly responsible for 'strategic' type tasks and the team leader has mainly day to day 'operational' autonomy. It may therefore be that team leaders working on the development of new products in some technical and industrial settings are being over managed, particularly in medium to low technology companies.

Early indications that management tends to delegate mainly 'operational' autonomy to the team leader or team were found in both the pilot interviews and pilot study. The findings in the overall

sample of the U.K. main study largely confirmed those of the pilot study except in the tasks of team de-selection and budget spending where there appeared to be some greater sharing of these tasks with the team leader.

In the supplementary chapter nine the U.K. sample was stratified by technology. Results indicated that more sharing of tasks appears to occur in companies of a medium to high technology nature and, when compared to the United States sample of electronics and software companies, suggests that technology may be a key determinant of task sharing and thus greater team leader autonomy. Analysing both samples by 'size' of company, that is in terms of the annual sales volume, indicated that 'sales turnover' may well be a determinant of greater delegation of 'strategic' task responsibilities. All this suggests that managers should consider relaxing their control over the project by providing a greater degree of autonomy to their team leaders. Greater autonomy = more responsibility for 'strategic' tasks.

The second chapter of supplementary findings, chapter ten, discussed the construction of the autonomy map, and factor analysis was used to demonstrate the underlying dimensions of project management. The subject of the Bailyn's (1985) autonomy map was discussed in chapter 3.5. In their research Bailyn (1985), Schein (1987) and Raelin (1989) conceptualised autonomy as a career issue, but the main area of interest for this research is based on Bailyn's concept of 'strategic' and 'operational' autonomy seen as a general management issue. Results have been presented to demonstrate a method of constructing an 'Autonomy Map' very much along the lines of that suggested by Bailyn but improving the method of measurement. Bailyn based her results on some empirical work carried out on a small sample of mainly technical professionals in an R&D setting using generalizations to define both 'strategic' and 'operational' autonomy. The data used by Bailyn to construct the autonomy map was based on employee self reports. Some researchers disagree as to whether variables such as autonomy should be assessed through employee self-reports. As a result of such criticism, a new instrument was developed that measures some common manifestations of team leader autonomy. This research conducted an empirical investigation into management's perception of autonomy, in this case, team leader autonomy. As discussed in chapter 3.5, such a map might usefully be used for assisting both managers and employees in the formal observation of an individual's performance at work, the annual employee assessment or appraisal. It may also serve as a means of tracking a career path and discussing new product development management in terms of an employee's continuous development programme. It was suggested in chapter 3.5 that the key objective of employee appraisal is the improvement of the performance of people in their jobs.

Thomason (1981) believes that to meet the

> '...varying demands on the work organisation as an environment for living, it may be necessary, as expectations of worker change, to think out new structures which offer opportunities for the development of different kinds of career for different kinds of people'
>
> Thomason (1981, p.338)

On the subject of career Schein (1971) suggested that organisations might define it as: 'a set of expectations held by individuals inside the organisation which guide decisions about whom to move, when, how and at what speed' (Schein, 19781, pp.401-402). Providing the team leader with an 'individual' autonomy map is a means of graphically indicating the type of role the team leader has in an organisation. A position on the autonomy map to the left of the oblique line shown in figure 3, p.46 is an indication that they play a more 'strategic' role than if they were positioned to the right of the oblique line, thus team leaders wishing to be administrators or managers of the development lab might expect their autonomy map score to be higher on the strategic axis and lower on the operational axis. One might therefore argue that an important part of the training process for continuous development is a dynamic approach whereby the individual is encouraged to understand more about their role in the company and objectives that could lead to improved, individual, performance.

11.3 Further Limitations

A number of limitations in this research have already been given in chapter 1.7. In addition to those discussed it is also worth keeping in mind other limitations when interpreting these results. First, is non random sampling. The samples were taken from registers of companies and were thus not random. Whilst every effort was made to ensure that samples were representative of the population the results need to be replicated by others. The second concerns the distribution of the sample in terms of the 'stratified' industry sector. Electronics and Software were well represented, but the sample included a few companies manufacturing electrical goods. Future researchers may wish to concentrate on a more homogenous group, say scientific instruments manufacture only, in order to define team leader autonomy in terms of that company type. Third, one of the disadvantages of postal surveys is the relatively low response rate often obtained as may be seen in this study, 22% U.K. and 15% U.S.A. It is possible that non response bias could be introduced where those that did not respond may hold entirely different views to those who did, thereby limiting the generalizability of the findings. Fourth, the classification used for coding into the computer must, to some extent, be subjective. Classifying company activity, even if SIC codes are used, is often subjective and thus prone to errors. Finally, the data used has come from senior development and R&D managers who 'perceive' their answers to be correct. Whilst every care has been taken to ensure that the questionnaire elicited correct responses, at the end of the day the researcher is dependent upon the respondent for accuracy in the answers given.

11.4 Conclusions, Pilot Study

11.4.1 Pilot Study Chart Data

An inspection of the pilot survey data revealed that for the U.K. overall sample, most of the management, or 'strategic', type of tasks tended to cluster around the senior manager, whilst the day-to-day 'operational' tasks were, generally, associated with the team leader or team. Senior management appeared to share the task of project selection criteria with the steering committee that is often made up of senior people.

11.5 Conclusions, Main Study

11.5.1 Selecting Team Leaders

In over 80% of the companies sampled, team leaders are selected by management and 54% used personal recommendation as the main criterion for the selection method. Only 17% of the sample of companies used psychometric tests. 72% of the respondent companies used other criteria to help in the method of team leader selection, mainly the track record of the individual and personal recommendation. In this study no relationship could be found between the method used to select the team leader and the degree of autonomy granted to the team leader. Future studies, however, may wish to consider whether in a larger, homogeneous, group of companies the method of selecting team leaders is a determinant of the extent that autonomy is granted to them.

11.5.2 Main Study Chart Data

This research concentrated on work method autonomy as discussed in chapter 3.4 and focused on the viewpoint of top management rather than the team leader with technical and business roles in new product development projects within companies. In the overall U.K. sample, 'strategic' task responsibilities appeared to be closely associated with senior management and/or the steering committee whilst 'operational' - day to day - tasks were more the domain of the team leader and team.

11.6 Conclusions, Supplementary Data

11.6.1 Stratified Data by Technology and Size

Management in medium to low technology companies did not tend to share 'strategic' tasks and only the 'operational' type tasks were shared with the team leader. Management style therefore appeared to be 'top down' in nature. However, there is evidence to suggest management's willingness to delegate more 'strategic' task autonomy to team leaders in the electrical/electronics/software sample of companies. In this research the findings suggested that technology may be a key determinant of team leader autonomy. The supplementary data provided in chapter nine also suggested that company size may be a determinant to a greater sharing of two key areas with the team leader, team issues and budget issues (team selection and budget spending in the U.K. and team selection and budget setting in the U.S.). Providing more autonomy to the team leader for these tasks could create greater project

efficiency by getting better use of human and capital resources, but this would be the subject of future studies.

11.6.2 U.S. Sample

Task sharing by stakeholders in the U.S. sample (chapter 9, figure 10) was similar to that of the U.K. sample stratified by medium to high technology (chapter 9, figure 9). However, two clear differences emerged. Budget spending appeared to be more closely associated with the team leader than in the equivalent U.K. sample. Also, the U.S. data indicated that the steering committee is significantly more involved in strategic and control issues than their U.K. counterparts. This important finding differentiated the management style of the U.K. and the U.S. The approach in the U.S. is for a greater sharing of 'strategic' task responsibility. The evidence found here suggested that in the U.S. senior management was more closely associated with the 'steering' or representative committee for a number of 'strategic' tasks than was the case in the U.K. and may indicate that the decision making process is more participative in nature.

11.6.3 Autonomy Maps

The method of constructing the 'Autonomy Map' was described in chapter 3.5. Bailyn (1985) designed a method of representing the degree of 'strategic' and 'operational' autonomy granted to R&D professionals by constructing a graph composed of strategic autonomy on the 'X' axis and 'operational' autonomy on the 'Y' axis. This method of determining management's perception of where an individual is positioned may serve as an improved career mapping tool and, if included as part of the annual personnel review process, a 'career barometer' for the team leader. The annual review, also known as annual appraisal, can serve to provide companies and employees with information about how the individual is progressing in a given career direction. It can inform the person being assessed as to how well he/she is doing in the eyes of senior management and indicates whether career progress is being achieved. Dependent on whether the individual seeks an administrative or technical career path, the 'autonomy' map provides a clear point of reference as to where he or she is positioned. For those wishing to see progress into a managerial role greater autonomy = more responsibility for 'strategic' tasks.

Managers may also wish to adopt a continuous development (CD) approach. According to Wood, Barrington and Johnson (1988) training managers that have adopted the CD approach have done so because they perceive that a dynamic, proactive attitude and approach is needed to enable individuals and organisations to spot and use the opportunities inherent in change (p.19). For example, team leaders displaying intrapreneurial characteristics might well be encouraged to advance beyond team leader status to a more entrepreneurial management role.

The positions of the team leader on the autonomy map for both the U.K. and U.S.A. were very similar. The average level of operational autonomy was practically the same in both countries. However, the average level of strategic autonomy in the U.S. was approximately 13% higher than that of the U.K. and suggested that U.S. companies tend to give their team leaders more strategic type autonomy, but this would need to be researched further.

11.6.4 Factor Analysis

The second chapter of supplementary findings, chapter ten, demonstrated the underlying dimensions of project management based on the U.K. stratified data of question 8, a Likert scale question. The U.K. factor data produced four factors that were interpreted as 'Project Scope', 'Team Issues', 'Project Development Life Cycle' and 'Tactical Issues'. The results suggested that in the U.K. Electronics/Software sector management perceived these four project factors to be important. In the U.S. factor analysis three similar factors emerged. The fourth factor, 'Project Planning', is different from the U.K. The difference in emphasis is interpreted to signify a difference in approach to project management in this industry sector. The U.K. managers appeared to consider 'Project Scope', that is elements of budgets and design, whilst the U.S. managers considered 'Project Planning', that is elements of budgets and project efficiency as important. Clearly this is speculative and needs to be researched further. However, both factor analyses were robust in their mathematical interpretation judging by their chi-square statistic and significance.

11.7 Summary of Chapter

This research has shown linkages between the distribution of responsibility for 'strategic' and 'operational' tasks and four key stakeholders (senior management, steering committee, team leader and team) in NPD. The analysis has shown that companies behave in distinct ways according to type of company (high tech, medium to low tech) and national context. Stratification of the sample tends to suggest that there could be a link between technology, company size and task sharing. Managers are encouraged to share greater 'strategic' responsibility with the team leaders. The autonomy map is described as a useful addition to the yearly appraisal and continuous development programme and the underlying dimensions of project management are discussed.

Chapter 12 Recommendations for Future Research

12.1 Introduction to Chapter

This section will comment on the conclusions discussed in the previous chapter and suggest recommendations for future research. Suggested areas of research are not ranked in any order of importance, but are reported in an order consistent with the conclusions.

12.2 Possible Areas for Future Research

In chapter 11.2 we discussed how quantifying team leader autonomy is practical from the point of view of identifying relationships created by how autonomy is granted. It was suggested that team leaders working on the development of new products in some technical and industrial companies may be over managed. We shall now consider some future research directions aimed at NPD in terms of performance at the individual level.

12.2.1 Task Autonomy

We discussed Boreham's (1992) international study of the organisation of work in advanced industrial societies which indicated several design aspects of work that are put into practice. He found that flexible production techniques and organisational forms do not appear to have 'usurped' the Fordist organisation of the labour process and there is little evidence in the data presented to suggest that participative organisational practices have made any significant incursion into traditional managerial prerogatives in the workplace in any of the countries studied.

We have seen in both the pilot and the main study that the overall responsibility for 'strategic' tasks in British companies appears to lie with senior managers. Much of the management literature reports a trend towards new patterns of work, greater industrial democracy, new relationships between employers and employees and changing attitudes towards risk and reward. If companies are to move to a more participative style of management a management audit may be appropriate. With this in mind, one possible area of research might be:

- to research management's perception of the skills required by team leaders in order for them to obtain more 'strategic' autonomy, 'Map' them against a current series of team leader skills reporting the gap which exists for estimating what training is required to develop team leaders into a greater managerial role involving more strategic and operational autonomy.

12.2.2 Sales Activity

One finding discussed in the supplementary chapter nine suggests that there is a possible link between sales volume of companies and team leader autonomy. We discussed in chapter 2.4 that the speed of response can be influenced by the company's technology portfolio. They may adopt a number of product market strategies including: 'first to market, second to market, me-too, me-better, and quick response' (McDonough, 1986, p.142). Large companies often find it difficult to keep pace with market developments, let alone stay at the leading edge of research whilst medium to small sized companies often lack the managerial skills that are required to complete the path between research concept and customer. This research has examined the data from companies for a link between team leader autonomy and their sales turnover using the qualitative measurement method of correspondence analysis which, although ideal for determining initial perceptions of task autonomy, can be improved through the use of more sophisticated analytical techniques such as correlations and regressions. By employing these techniques and by modifying the research instrument to address the subject of autonomy more directly, it should be possible to examine 'stratified' companies for the degree of autonomy granted to the team leader against a background of sales activity. Therefore one area of research might be:

- to investigate whether annual sales is a determinant of team leader autonomy.

12.2.3 Dynamic and Hostile Environments

Miller's (1983) research on the correlates of entrepreneurship in three types of firm and Morris, Avila and Allen's (1993) research on entrepreneurship and individualism, support a market environment argument. Organic firms typically attain growth internally through NPD and by striving to be adaptive to their environment. Miller (p.775) articulates that 'the more dynamic and hostile the environment, the more firms will be entrepreneurial. Since firms try to tailor their actions to the environment, they will gear their entrepreneurial efforts to the demands of their markets.' A key part of these efforts is likely to be in the effective use of human resources in response to market changes.

One area of research might be:

- to investigate to what extent turbulent market growth may predict the level of team leader 'strategic' task autonomy in various stratified samples.

12.2.4 Product Life Cycle and Market Share

In this research team leaders did not appear to have much 'strategic' autonomy in the overall U.K. data set, but in high tech companies such as electronics and software manufacture with short product life cycles (PLC) it is quite likely that PLC and market share may have an impact on the degree and nature of autonomy granted to the team leader.

Two independent areas of research might be:

- to investigate a possible link between market share and team leader autonomy in high tech companies.
- to investigate a possible link between product life cycle and team leader autonomy in high tech companies.

12.2.5 Factor Variables

Chapter 11.6.4 discussed a difference of emphasis between the U.K. and U.S. data which suggests that the sample of U.K. managers appears to perceive project finance as an item of interest, whereas, the data for U.S. managers suggests that planning is perceived to be a factor of interest. Therefore an area of research might be:

- to investigate and explain the subtle difference between the ordered factor data of the U.K. and the U.S.A. for the purpose of better understanding country differences in approach to project management in NPD.

12.2.6 International Dimension for Task Autonomy

This research has dealt with team leader autonomy in NPD for both the U.K. and U.S.A. What is needed is an international test instrument for task autonomy in NPD which might predict levels of team leader autonomy under a wide range of conditions. Therefore one further research area might be:

- to develop an international test instrument for team leader 'task' autonomy in NPD: 'strategic' and 'operational'.

12.3 Summary of Chapter

Several areas for future research have been suggested. Task autonomy may be shared between four stakeholders according to the technology used and, possibly, the size of companies by sales volume. It was suggested that organic companies operate in dynamic markets and product market variables may be a determinant of the degree of autonomy granted to team leaders. Factor analysis may explain

national differences in approach to project management and an international dimension for task autonomy was proposed.

12.4 Concluding Discussion

This work has primarily concentrated on defining the nature and degree of autonomy given to (project) team leaders. Initially, the pilot interviews used grounded theory as an analytic means to generate theory. A further aim was to identify common themes and patterns from the data which could be used as a basis for interpretation. For the purpose of this thesis the strategic variables and operational variables were defined using current terminology within the industry, NPD and related literature. The 'strategic' variables concerned major project actions in new product development: new projects ('project selection'), human resources ('team selection', 'team de-selection'), financial resources ('budget setting', 'budget spending') and allocating rewards ('rewarding team success'). The 'operational' variables are elements of the product development and project management process from conception to completion ('project design', 'project planning', 'project scheduling', 'project implementation', 'project deadlines', 'project review' and 'project evaluation').

Based on the results of pilot interviews and both the pilot and main study questionnaire findings it appears that the notion of participation and participative management style as being more appropriate to the management of skilled workers as suggested in management literature (McGregor, 1960; Likert, 1967; Ouchi, 1981; Kanter, 1983; Bennis and Nanus, 1985; Handy, 1985) is not evident in this broad sample of NPD companies. The general conclusion of this research is that management in NPD today still focus their efforts on centralising 'strategic' tasks and delegating 'operational' tasks to the team leader and team.

There can be little doubt that the delegation of 'strategic' tasks is an important issue to all companies. According to Peters and Waterman (1982), in many of the top performing companies in the U.S.A. some individuals are given a 'limited autonomy position', meaning a position that has substantial entrepreneurial, champion-like qualities, but is actually quite constrained and exists in a much broader setting than one might expect (p.212). Making this form of autonomy work involves socialising the team leaders into believing they are would-be 'champions', but at the same time maintaining substantial corporate control where it counts. One cannot expect top management to abrogate responsibility for directing and managing the company but at the development level the team leader could have autonomy granted to: achieve agreed objectives, select a team of people to undertake tasks, implement the project primarily by assigning work to individuals and control its progress.

Senior management has to make decisions about its involvement in NPD not least because regular and timely success in new product development is necessary for their companies to survive and grow. The literature suggests that some hierarchical control can stimulate innovation and argues that

understanding the managerial context of control is as important as the degree of autonomy delegated by senior management. High levels of perceived control are associated with high levels of job satisfaction, commitment, involvement, performance and motivation, particularly when providing the individual with as much 'independent discretion' as possible. Too much control can lead to reduced job satisfaction, commitment, involvement, performance and motivation (Peter and Waterman, 1982, p.322).

All companies, regardless of size, should be concerned with developing new products and new markets and creating new business opportunities. For companies in growth markets, growth can be achieved by means of acquisition and by internal or organic growth. Organic growth is based on research and development programmes, on a strong presence in the market place and on the strength and credibility of the corporate body. Smaller companies often find that the innovation process is based on a fast response to market opportunities and on the rapid application of new technology as well as the entrepreneurial flair of the management team. It would be interesting to know how far top management is aware that they are giving more autonomy, the higher the technology employed. It is possible that they are unwittingly stifling the entrepreneurialism of their team leaders in lower technology companies or could it simply be that top management is much more involved in new product development activities than in higher technology companies?

Several recommendations for future research have been made. Throughout all stages of the research no evidence was found that managers were aware of the role of the firm's environment on influencing team leader autonomy. It is proposed that practitioners will benefit from reflecting on general practice in their company and within their industry. The autonomy granted to team leaders may be influenced by environmental factors more than top managers are aware. Such questions need to be considered if companies are to improve their management of new product development and better understand the role of the external environment on their internal management practice.

It is proposed that a useful tool for mapping career paths might be the 'autonomy' map modified from the original proposed by Bailyn (1985). The annual review, also known as annual appraisal, has already been referred to earlier. It is generally felt that it might serve to provide companies and employees with information about how their career is developing. It should be possible to discuss the 'autonomy map' as part of their appraisal. It can act as a tool for discussion and may serve to inform the person being assessed as to how well he/she is doing in the eyes of senior management. For example, Bailyn placed the mature professional in the middle of an autonomy grid and identified different career paths for R&D professionals dependent on whether the individual focused on research management, high level technical co-ordination or research fellowship. The improved 'autonomy' map used in this work is based on identifying common manifestations of 'strategic' and 'operational' autonomy. The data used for construction came from management as opposed to the original

employee 'self' reports and reflects management's perception of employee autonomy and is, therefore, an ideal tool to be used in conjunction with an employees' continuous development programme.

Many employees do not see the concept of 'security' as it was perceived by the older generation but as one in the context of opportunity; not to stay as one is, but to grow as one progresses through life. 'Not everyone wants such opportunity; some prefer to stay put, re-experiencing the known and the familiar. Others more actively seek chances of learning new things and experiencing new challenges' (Thomason, 1981, p.338). The writer believes that if the concept of the autonomy 'map' is used in conjunction with an effective appraisal and continuous development programme it is likely to lead to greater motivation and challenge to the individual.

This research gives a very different picture of team leader autonomy than the one portrayed by the recent 'excellence' literature. It suggests that old fashioned environmental contingency theory - very much out of vogue in the mid 1990's - has important insights for both academics and practitioners and, most important, the conceptualisation of NPD as 'strategic' and 'operational' tasks shared by a group of stakeholders is offered as one means by which practitioners can more effectively manage their business and innovate.

APPENDICES

APPENDIX A

Example Interviews 3 and 13, Transcripts

Interview 3 Company 'X' Chicago, Illinois, U.S.A.

(Organisation structure)

As Project Manager *(PM)* - Team Leaders (*Stakeholder 3*) communicate directly to the Executive Committee *(Stakeholder 2, Proj. Selection Criteria)* without project manager in the middle. Only when Team Leaders *(Stakeholder 3)* can communicate in a very concise fashion or when the team *(Stakeholder 4)* needs input from Executive Committee *(Stakeholder 2)*. On the present project the Team Leader (*Stakeholder 3*) is working with the CEO *(Stakeholder 1)* - the obvious expert. Ideally every project is that way without a project manager.

(How to get team together)

Resources Manager *(Stakeholder 1)* knows experience level of key staff *(Stakeholders 3 & 4)* - knows what they have done and are likely to be involved in. Tries to match people *(Team Selection/De-Selection/Rewarding Team Success)* with their interests. Team Leaders (*Stakeholder 3*) in pairs - always representative from marketing with technology representative. Several projects *(NPD)* are on-going at same time. Two project managers at the beginning of a project - one marketing and one technology. At the beginning of starting market requirements and studying the market, the marketing project manager would be in charge. This is a short phase. Then it moves into engineering design *(Project Design)* and construction (*Project Planning/Scheduling/Implementation*), testing (*Project Reviews/Evaluation),* which is considered factory work and that is the responsibility of the technology managers.

Technical writers, product marketing analysts, programming analysts, all work for the project manager. Team leaders would have complete authority and responsibility (*Budget Setting/Spending*) over their project, to the point that they talk directly to senior management *(Stakeholder 1)*. If they want me (*Stakeholder 1*) to do anything they talk, but if not they produce their own status reports *(Proj. Reviews/Deadlines)* and go about their own business'.

(When project nears completion?)

Once the product is ready the Marketing Project Manager takes over. He organises training, brochures, press releases. Every Team Leader *(Stakeholder 3)* is involved in both production work and factory work *(NPD)* as well as some aspect of the marketing. Some may be managing their own small product *(NPD)* in a big new version of the software, but at the same time may be involved in marketing. As participation *(Participation)* in production activities runs down, he becomes more involved in marketing, training pre-sales people, going round the world to branch offices - but not involved with clients. Trains own professional services organisation *(Organisational Structure)* to carry out implementations and courses.

Teams *(Stakeholder 4)* that are accountable, empowered *(Hierarchy)* and have the right skills for their assignments have good morale. Teams *(Stakeholder 4)* that are struggling, either because they have a very tough assignment, don't have the right skills, or a bad mix of personalities, don't feel empowered *(Hierarchy)* and tend to have very poor morale - that means there is a lot more management participation *(Stakeholder 1 & Participation)*.

Skills are not a deciding factor whether a team *(Stakeholder 4)* is successful or not - probably more problem solving ability. People who have never dealt with similar scheme will still make good team leaders *(Stakeholder 3)* by ambition, intelligence, - skills only become part of the equation after all the other dynamics are there - we do hire motivated, bright, intelligent people.

Having qualified team leaders *(Stakeholder 3)* is the biggest single factor for a successful project - unsuccessful teams *(Stakeholder 4)* have a team leader without leadership skills, not good communicators. Team leaders *(Stakeholder 3)* do well in ambiguous situations, and have the ability to measure how people are feeling, how to motivate people, and identify tasks.

(Opportunity to exchange knowledge)

I only interact with people in the team because of my own background knowledge, not because I am project manager *(Stakeholder 1)*. I do not ask if the team is on time or doing tasks right - I act more as a tutor or someone who is available if the team needs assistance. Team leaders *(Stakeholder 3)* are the leadership for the entire project team. They interact with each other without me being present. They communicate to the team any messages which we might need to get to anybody in the team, which allows them to be sensitive to the way that people are motivated or the way people would react to certain information. There is a great deal of co-operation with team leaders and across teams; team leaders co-ordinate skills that are needed from one team to the next. Teams *(Stakeholder 4)* meet on a regular basis. Each team has their own project room - there is an informal process, but essentially for the concept of the joint application development it is critical that people share skills. We cannot have an accountant and a technical designer trying to figure anything out unless they have sat down for several hours to try to understand the vocabulary of the other person. There is a great deal of interaction.

(In what way do teams share in the financial success of the company?)

Probably not at all. No profit sharing plan *(Proj. Resources)*. Bonus programme, a lot geared around the quarterly deliverables *(Proj. Deadlines)* of the teams. There's an incentive stock option programme that when you get to a certain point of contributions to the company, the company does give stock options to some of the key designers and the people with key products.

(Reason why team is better than another in terms of reward factors and what are those reward factors?)

We have tried external rewards, but these were not effective. Offering extra money for extra hours, etc. does not motivate people. No other way than having team leaders *(Stakeholder 3)* to motivate. Matrix help. - aiming for rate; quality - how to reach this level - helps more than money or rewards. Star performers in a team *(Stakeholder 4)* would be same on their own, regardless of being in a team, having the ability to take a lot of people with them.

(Are there career paths?)

These individuals may leave to form their own companies - probably not as successful - but it is a typical way to leave the company.

Internal reward structures - most managers *(Stakeholder 1)* in technology were team leaders *(Stakeholder 3)* at times. 75% of the managers in the technology division are internal promotions. There are great opportunities outside technology as well - Vice Presidents in client services group and in pre-sales organisation are always actively pursuing people from technology to join them.

In technology it is not only careers advancement, contrary to a flat organisation - how many people can be managers?

(Often people do not wish to be managers, just looking for a challenging job)

We have a number of people whose motivation is to continue to grow in new technologies - we keep them moving from one software, one hardware, one language to another - so that they continue to be challenged; we do provide a lot of recognition to those people who are star performers, recognition in company meetings, personal recognition by the senior Executive Committee *(Stakeholder 2)*. People who perform well are known throughout the organisation, they develop personal relationships with the senior executives *(Stakeholder 1)*, are asked for advice, and consulted on different opinions they might have. This is very rewarding.

Interview 13. Company 'Y' Basingstoke, U.K.

How are Intrapreneurs selected ?

There are three ways that product champions, team leaders *(Stakeholder 3)* or project leaders or what ever you want to call them can come about *(Proj. Resources: Team Leader Selection)*.

The first, classic function way. Management *(Stakeholder 1/2)* decides we want to make something and a decision is made to make it *(NPD, Project Selection Criteria)* and fund it *(Budget Setting/Spending)*. There are less and less of those projects *(NPD)*.

The second way and which is happening a lot is where the Intrapreneur (*Team Leader, Stakeholder* 3) decides that he thinks that the business ought to do something. Some *(Stakeholder 3)* will write a report about it and go up front very quickly. This works well for non contentious issues. If someone thinks we ought to change the formulation of something or whatever, he writes a letter and then goes and skunks it *(Organisational Structure)* (does it) and we have a lot of problems with that. The product *(NPD)* doesn't get controlled *(Project Control)* in the same way, other people don't have an input *(Participation)*. We don't have skunking *(Organisational Structure)* because there is not a lot of time available. If you don't skunk *(Organisational Structure)* then you use an LOI or a BAR. (Letter of Intent, Business Activity Report). They can lobby too.

We have business meetings every day where everyone can join in. If it is an interesting idea, we will commit or allow time for the individual to flesh out the idea *(Project Technology)* by working with people in other disciplines *(Stakeholder 4)*. That person puts forward a plan *(Stakeholder)* which says that for 'X' amount of investment *(Capital)* and so many people we can achieve this and have 'X' amount of benefit.

At that stage the management team *(Stakeholder 2)* decides whether they want to approve the BAR, or say, well thanks but the return is not big enough or whatever. That is the second approach which is individually driven.

The third route is where the management *(Stakeholder 1)* take the decision on their own based on a BAR, or an issue and decide in five minutes to appoint their own product champion or Intrapreneur (*Stakeholder 3)* to run with the project. It could be as a result of some lobbying that has been going on for some time. Some coalition building by someone. I (*Stakeholder 1)* have been involved in some of this activity.

We have used parts of the British Airways putting people first programme and part of the personal quality programme. Because of the pressures on us we trained a lot of people, we were looking for an

interested neutral champion. I was given the job. The quality guy transferred to me from R&D *(Stakeholder 4)* and we worked together on the programme.

We decided to appoint a project leader *(Stakeholder 3),* the right kind of guy and allowed him to pick his own team (*Stakeholder 4, Team Selection/De-Selection*) from anywhere in the business. All the people come from various functions (matrix form) but they have got a project *(NPD)* which has to deliver a real tangible project by period 4 of *(Project Control: reviews, evaluations, deadlines)* next year. We co-located all the people (*Stakeholders 3/4*) into the same area and gave them a three day intensive team building experience to try and weld them into a fighting unit. This is a departure for us since many of the functional people *(Project Manager)* are not comfortable with the fact that one of their people *(Team)* they don't have control *(Hierarchy)* over who works in a different area. Who is controlling them?

This is an area of social experimentation that we are embarking on now.
They have formed a mini company.

Let's come back to the one person (Stakeholder 3) you have chosen to pick his own team. The project was chosen by whom? (Project. Technology). Him or management?
It was a project *(NPD)* which had already been running, but people *(Stakeholders)* had started to become uncomfortable with it. When we started to involve customers in the end design *(Project Technology)* and they saw how the product *(NPD)* was evolving *(Proj. Life Cycle)* they did not like it. So we came to the decision to stop this project and re-launch it with another team and leader *(Stakeholders 3 & 4).* It needed a different quality and feel to it.
The guy we picked was in marketing on that brand, has good potential and was an engineer. He can talk to marketing and he speaks R&D speak. (Intrapreneur material)

When you set these people up, do they work within any special organisational structure?
Sometimes, but not normally.
Company X has always been structured *(Organisational Structure)* around the usual functional lines of manufacturing, commercial, R&D and Marketing etc.

You mentioned earlier that you draft in others. When you put them in together do they report to one person.?
They work in a matrix organisation. We tried to get all the right types of team *(Proj. Resources & Stakeholders 3 & 4)* elements needed, so more than one of them works in more than one team. Individuals still have a reporting *(Project Control)* relationship to their line boss. It can and does present us with problems occasionally.

What happens to the Intrapreneur once the project is finished.

We never have a problem, we rotate them into other areas or projects.

What happens is that those who can manage different functions (*Project Design/Planning/Scheduling/Implementation/Reviews/Evaluation/Deadlines, Rewarding Team Success*) end up being seen as more mobile by the management *(Stakeholder 1)* and used in other areas. People who make things happen across the business don't see themselves as functional people. They ask themselves how to get things done and by whom. They interact with people, and get known for it. Unless they blew out on a project. Then it becomes more of a problem.

In terms of the team leader. Is there a mechanism for rewards? Is it done by a strict formula?

We have a management by objectives, with yearly appraisals We pay well and reward people *(Proj. Resources)* according to the appraisal and a pay scale. We don't believe a person is a failure, they are only in the wrong job function.

How much control do you exercise over the team leader or team?

Every team leader has full responsibility *(Hierarchy).*

How full is full?

Everything, they sign off everything. Complete empowerment *(Hierarchy).* Full budget responsibility *(Capital).*

At the team level how is that? How free are they to do what they need to do?

They are very free. *(Hierarchy).* We have trained people to believe that they are mutually responsible *(Participation)* otherwise they are a group. They meet twice a week and they sit in the same room. They take joint decisions *(Stakeholders 3 and 4)* like the prime minister and cabinet must put his case. He can of course override their decision *(Hierarchy).* But we encourage joint decision making *(Participation)* to try and get the best decisions.

You mentioned close proximity of the team, is that literally the same room?

We have moved desks so that they sit side by side. You need people *(Stakeholders)* to interact, you can't dictate when an idea *(NPD)* is going to arrive.

If you put a chap in charge of a product, does he pick the team?

In the latest case, he does *(Hierarchy).* That is a new departure for us. We decided to do something radical.

How big are team sizes?

This one has 9 people. 10, I find is too many. Proper team *(Stakeholder 4)* dynamics don't really work when the team is larger than ten. Also you might not share the same objectives.

Do you have a measure whereby you can say that this team is working well? Do you have any means of measuring that they have collective responsibility?

Last Thursday I had a meeting *(Project Control)* with the team, what extra training should they have had in the team building session which they should have had (in hindsight) and what did they have which was possibly a waste of time? We had a review *(Project Control)*. By spending half an hour in one of their meetings you can achieve a lot. You could feel the energy even in the two members that were added later. (He didn't in fact answer his own question).

If you were to think about the success of your teams, is there anything specific which would automatically make the team a success?

Yes, one of the things is to look at the teams that fail. Basically, it rests with the team leaders that are not good leaders *(Stakeholder 3)* Either they have a bad project *(NPD)*, and that is management *(Stakeholder 1)* fault too, or they are bad leaders, they didn't believe in it. They only paid lip service to it. The successes are largely because of the team leader *(Stakeholder 3)*. He wanted it to happen.

What do you do with team leaders that fail?

Possibly nothing because it might have been an extra-curricular activity and the project *(NPD)* might have been in addition to their normal work.

Is there forgiveness for failure or do you clamp down?

You live in a hard environment. You are only as good as you last order. Yes we do forgive, but we never invite those people to be project leaders *(Stakeholder 3)* again. However they can continue and do a good job in their own function.

We have found people operating in teams *(Stakeholder 4)* that are clearly anti-social. We then try to help the individual to find a position in a different career. Some of these problems are not issues of conduct, they are about working with people.

APPENDIX B

Sample Letters, Pilot and Main Study Questionnaires and Clarification of Some Terms Sent to Respondents

LETTER SENT WITH PILOT STUDY QUESTIONNAIRE

26th April 1994

Dear Sir

A Research Project is currently being undertaken into Innovation. The research is sponsored by Henley Management College

So far personal interviews have been conducted with leading edge companies both in the U.K. and the United States (Software Development, Semi-conductor components Manufacturers, and Electronics Hardware Manufacturers) and we are now engaged in a survey of similar types of companies.

Please find enclosed a questionnaire for completion by the person in the firm chiefly responsible for Research and Development, or New Product Project Management

It would be greatly appreciated if you could complete this questionnaire and return it in the reply paid envelope, if possible by May 20th, 1994.

If you would like a summary of the results, please indicate so on the last sheet of the questionnaire.

Our interest is in analyzing broad trends rather than what is happening in individual cases. I can confirm that no companies and respondents to the questionnaire will be mentioned by name in the project reports and other publications.

Thank you very much for your co-operation.

Yours sincerely

Dennis Haslop
Research Associate

ENTREPRENEURIAL PRODUCT DEVELOPMENT

Company:..... **Position**.....

Name and Address:

.....

Product Markets:

(1) What is your company's main area of business? - Please tick one box only

- ☐ Software Design
- ☐ Hardware
- ☐ Scientific Instruments
- ☐ Industrial Instrumentation
- ☐ Components Manufacturer
- ☐ Other (please specify)

(2) In what range was the sales revenue for the financial year 1992-1993

- ☐ less than £1 million
- ☐ £1 million - £4.9 million
- ☐ £5 million - £9.9 million
- ☐ £10 million - £19.9 million
- ☐ £20 million - £49.9 million
- ☐ more than £50 million

(3) For your 3 highest sales revenue earning products during the period 1991-1993, what is the estimated product life cycle, market growth rate and market share?

Product	Life Cycle (months)	Market Growth Rate %	Market Share %
Highest			
Second			
Third			

(4) For your three most strategically important new products during 1994-1996, what is the estimated product life cycle, market growth rate and market share?

Product	Life Cycle (months)	Market Growth Rate %	Market Share %
Highest			
Second			
Third			

(5) For the last two years, give the approximate number of new products and estimate the percentage of total sales revenue

Year	Approximate Number of New Products	Percentage of Total Revenue
1992		
1993		

(6) What percentage of products developed were completed on time in:

1993: .....% 1992: .....%

(7) In terms of Sales Revenue, what percentage of products over 1991-1993 were leading edge technology? .....%

(8) In terms of Sales Revenue, what percentage of products are planned to be leading edge technology during 1994-1996? .....%

(9) Is the market strategy for the 3 predicted highest sales revenue earning products in 1994-1996? (please tick one box only)

☐ Technology leader ☐ Market leader (highest market share)

(10) Over the period 1989-1993, what has been the average percentage of Sales Revenue:

spent on R&D? .....%

What percentage of the R&D Budget was allocated for new products ?

.....%

Management:

(11) Who has main responsibility for selecting the Team Leader? - Please tick one box only

☐ Senior Manager ☐ Self-selection

☐ Steering Committee/Exec. Committee ☐ Other, (please specify)

(12) Who is primarily responsible for the following:

	Senior Mgt	Steering Committee	Team Leader	Team	Other pls specify
Team Selection	☐	☐	☐	☐	☐
Team De-selection	☐	☐	☐	☐	☐
Budget Setting	☐	☐	☐	☐	☐
Budget Spending	☐	☐	☐	☐	☐
Project Selection Criteria	☐	☐	☐	☐	☐
Project Design	☐	☐	☐	☐	☐
Project Planning	☐	☐	☐	☐	☐
Project Scheduling	☐	☐	☐	☐	☐
Project Implementation	☐	☐	☐	☐	☐
Project Reviews	☐	☐	☐	☐	☐
Project Evaluation	☐	☐	☐	☐	☐
Project Deadlines	☐	☐	☐	☐	☐
Rewarding Team Success	☐	☐	☐	☐	☐

(13) Given adequate managerial competence, what degree of control do you think the team leader should have: (please tick one box only)

	the same	more
Team selection	☐	☐
Team de-selection	☐	☐
Budget setting	☐	☐
Budget spending	☐	☐
Project selection criteria	☐	☐
Project design	☐	☐
Project planning	☐	☐
Project scheduling	☐	☐
Project implementation	☐	☐
Project reviews	☐	☐
Project evaluation	☐	☐
Project deadlines	☐	☐
Rewarding team success	☐	☐
Other, (please specify)		

(14) On average, how many teams are managed by the team leader at any one time?

.....

(15) What is the average size of the product development teams?

.....

(16) What is the average number of teams that a team member works in at any one time?

.....

(17) How many levels of management are there between the board and the junior team member?

.....

(18) What is the maximum number of levels of management between the team leader and the board?

.....

(19) How many direct reporting relationships do team leaders have on average?
(e.g. steering committee + product marketing manager + discipline manager = 3)

.....

(20) Any comments: (please continue overleaf if necessary)

Thank you for completing this questionnaire. Please return toSender

I would like a summary of the results ☐

PILOT STUDY

CLARIFICATION OF SOME TERMS

Question 3

Product Life Cycle	=	Introduction of Product to point of maturity
Market Growth Rate	=	Increase/Decrease in growth of market/year
Market Share	=	Percentage of market occupied by your product

Question 12

Who is primarily responsible for the tasks listed

If more than one person is responsible, please tick the appropriate boxes

LETTER TO U.K. COMPANIES, MAIN STUDY

24 February, 1995

Dear

Re: The Role of Team Leaders

I am conducting some research into the role of the Team Leader in New Product Development and Technology, and would appreciate your input. Enclosed is a short questionnaire which is largely a matter of ticking boxes, with a few exceptions - roughly estimated product life cycle, market share and market growth.

Would you be kind enough to assist us by filling in this very brief questionnaire and returning it in the enclosed reply paid envelope.

My interest is in analysing broad trends rather than what is happening in individual cases, and I confirm that no companies nor respondents to the questionnaire, will be mentioned by name in any of the reports produced.

Your cooperation is regarded as most valuable, and once the final study is completed I would be happy to send you a synopsis of the results.

Yours sincerely

Dennis Haslop M.B.A.
Research Associate

Project Team Leaders in New Product Development

Name: ..... Position: .....

Company name and address: .....

.....

Product Markets:

1 What is your company's main area of business? Please tick one box only

- ☐ Software Design
- ☐ Hardware
- ☐ Scientific Instruments
- ☐ Industrial Instrumentation
- ☐ Components Manufacturer
- ☐ Other (please specify) .....

2 In what range was the sales revenue for the financial year 1992-1993?

- ☐ Less than £1 million
- ☐ £1 million - £4.9 million
- ☐ £5 million - £9.9 million
- ☐ £10 million - £19.9 million
- ☐ £20 million - £49.9 million
- ☐ More than £50 million

3 For your company's highest sales revenue earning product during the three year period 1991-1993, what is the estimated product life cycle, market growth rate and market share?

Life Cycle (months)	Market Growth Rate %	Market Share %

4 Over the period 1989-1993, what has been the average percentage of sales revenue per annum spent on R&D for New Product Development

_____ %

Management:

5 Who has main responsibility for selecting the Project Team Leader?
Tick one box only

- ☐ Steering Committee
- ☐ Senior Manager
- ☐ Team Leader (self-selection)
- ☐ Other (please specify) .....

6 When selecting the Team Leader which methods are used?
Tick as appropriate

- ☐ Interview by committee
- ☐ Psychometric tests
- ☐ Personal recommendation
- ☐ Other (please specify) .....

7. Who is primarily responsible for each of the following tasks?

Please tick only one column per task

TASKS	Senior Management	Steering Committee	Team Leader	Team	Other (please specify)
Team Selection					
Project Reviews					
Budget Setting					
Project Deadlines					
Rewarding Team Success					
Project Design					
Project Planning					
Team De-Selection					
Project Implementation					
Budget Spending					
Project Evaluation					
Project Scheduling					
Project Selection Criteria					

8. On a scale of 1-7 what degree of autonomy would you say the team leader has?

Please circle in each case

	very low						very high
Team Selection	1	2	3	4	5	6	7
Project Reviews	1	2	3	4	5	6	7
Budget Setting	1	2	3	4	5	6	7
Project Deadlines	1	2	3	4	5	6	7
Rewarding Team Success	1	2	3	4	5	6	7
Project Design	1	2	3	4	5	6	7
Project Planning	1	2	3	4	5	6	7
Team De-Selection	1	2	3	4	5	6	7
Project Implementation	1	2	3	4	5	6	7
Budget Spending	1	2	3	4	5	6	7
Project Evaluation	1	2	3	4	5	6	7
Project Scheduling	1	2	3	4	5	6	7
Project Selection Criteria	1	2	3	4	5	6	7

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE. PLEASE TICK THE BOX IF YOUR WOULD LIKE A SUMMARY OF THE RESULTS. ☐

MAIN STUDY

CLARIFICATION OF SOME TERMS

Question 3

Product Life Cycle	=	Introduction of Product to point of maturity
Market Growth Rate	=	Increase/Decrease in growth of market/year
Market Share	=	Percentage of market occupied by your product

Question 7

Who is primarily responsible for the tasks listed

If more than one person is responsible, please tick the appropriate boxes

LETTER TO U.S.A. COMPANIES, MAIN STUDY

December 1994

Dear

At Henley Management College, research into New Product Development is taken very seriously and, as part of a program, I am looking at the role of the Team Leader, and would be most grateful if you could spend a few moments filling in what is basically a brief eight question survey, most of which is multiple choice. My interest is in analyzing broad trends, rather than what is happening in individual cases.

Your input would be most valuable and in order to make it as simple as possible, I enclose a postage paid envelope for its return. An early reply will be most appreciated.

I can confirm that no companies or respondents to the questionnaire will be mentioned by name in the project reports and other publications.

Thank you for your cooperation

Yours sincerely

Dennis Haslop M.B.A.
Research Associate

Project Team Leaders in New Product Development

Name: ..... Position: .....

Company name and address: .....

.....

Product Markets:

1 What is your company's main area of business? Please tick one box only

- ☐ Software Design
- ☐ Hardware
- ☐ Scientific Instruments
- ☐ Industrial Instrumentation
- ☐ Components Manufacturer
- ☐ Other (please specify) .....

2 In what range was the sales revenue for the financial year 1992-1993?

- ☐ Less than $2 million
- ☐ $2 million - $9.9 million
- ☐ $10 million - $19.9 million
- ☐ $20 million - $39.9 million
- ☐ $40 million - $99.9 million
- ☐ More than $100 million

3 For your company's highest sales revenue earning product during the three year period 1991-1993, what is the estimated product life cycle, market growth rate and market share?

Life Cycle (months)	Market Growth Rate %	Market Share %

4 Over the period 1989-1993, what has been the average percentage of sales revenue per annum spent on R&D for New Product Development

_____ %

Management:

5 Who has main responsibility for selecting the Project Team Leader?
Tick one box only

- ☐ Steering Committee
- ☐ Senior Manager
- ☐ Team Leader (self-selection)
- ☐ Other (please specify) .....

6 When selecting the Team Leader which methods are used?
Tick as appropriate

- ☐ Interview by committee
- ☐ Psychometric tests
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- ☐ Other (please specify) .....

7. Who is primarily responsible for each of the following tasks?

Please tick only one column per task

TASKS	Senior Management	Steering Committee	Team Leader	Team	Other (please specify)
Team Selection					
Project Reviews					
Budget Setting					
Project Deadlines					
Rewarding Team Success					
Project Design					
Project Planning					
Team De-Selection					
Project Implementation					
Budget Spending					
Project Evaluation					
Project Scheduling					
Project Selection Criteria					

8. On a scale of 1-7 what degree of autonomy would you say the team leader has?

Please circle in each case

	very low						very high
Team Selection	1	2	3	4	5	6	7
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Project Design	1	2	3	4	5	6	7
Project Planning	1	2	3	4	5	6	7
Team De-Selection	1	2	3	4	5	6	7
Project Implementation	1	2	3	4	5	6	7
Budget Spending	1	2	3	4	5	6	7
Project Evaluation	1	2	3	4	5	6	7
Project Scheduling	1	2	3	4	5	6	7
Project Selection Criteria	1	2	3	4	5	6	7

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE. PLEASE TICK THE BOX IF YOUR WOULD LIKE A SUMMARY OF THE RESULTS. ☐

APPENDIX C

Interpreting SPSS ANACOR Results

Interpreting SPSS. ANACOR results

Interpreting the results from SPSS ANACOR solutions is best achieved by applying some simple rules.

1) examine whether there is any significant dependency between column and row data.

i) a dependency is another way of saying that a relationship exists between row and column data and for this we may generally accept a rule of thumb measurement of dependency as being the square root of the total inertia, $\sqrt{I}=D_p$ (dependency). If the value of D_p is greater than 0.2, there is seen to be 'dependency'. Table 2, chapter 7 is reproduced below.

Dimension	Singular Value	Inertia	Proportion Explained	Cumulative Proportion
1	.50202	.25202	.766	.766
2	.25242	.06372	.194	.960
3	.11536	.01331	.040	1.00
		--------	--------	--------
Total		.32905	1	1

Table 2 Dimensionality

The square root of the total inertia amounts to 0.5736 indicating that a relationship exists.

ii) The inertia is also a measure of 'goodness of fit' of the solution. Table 2 shows that the total inertia =0.32905, which is the square root of 0.5736. This indicates the solution as representing 57% of the variability of the original data.

2) The next step is to establish the number of dimensions which contribute significantly to the interpretation of the original contingency table. This is usually based on the proportion of the total inertia which is explained by each dimension/axis. In this instance, table 2 shows that 2 dimensions contribute 96% of total inertia available, thus 2 dimensions provide an adequate representation.

3) The third step is to interpret the meaning of the two dimensional plot. It is necessary to understand each dimension and the contribution of each row/column point to that dimension, focusing on the ones with the highest contribution since these are likely to be the most important positions in the dimension. The positions of greatest interest to this study are those of the 'strategic' tasks which are represented by dimension, since the study is interested in task autonomy. The positions occupied by 'responsibility' are less likely to be meaningful since they represent the points against which the tasks are associated. On the horizontal 'X' scale (Dimension 1) are the relative positions of the tasks. As may be seen from the following table the contribution to inertia of each row point is a follows:

Contribution of dimensions to the inertia of each row point:

TASK	Marginal Profile	Dim 1	2	Total
1 A	.057	.971	.002	.974
2 B	.075	.061	.541	.601
3 C	.080	.938	.037	.975
4 D	.077	.107	.846	.953
5 E	.075	.759	.239	.999
6 F	.081	.835	.015	.849
7 G	.080	.909	.090	.999
8 H	.078	.944	.004	.948
9 I	.080	.862	.053	.915
10 J	.082	.146	.381	.527
11 K	.082	.006	.949	.955
12 L	.079	.202	.539	.741
13 M	.073	.867	.123	.990

Taken together the dimensions have relatively high totals, many being close to '1'. Also the variances are quite low, indicating a goodness of fit. To the left of the 'dotted' line in chart 1 chapter 7, the tasks appear to be more closely associated items of a strategic management nature such as, A (team selection), B (team de-selection), C (budget setting), D (budget spending), E (project selection criteria) and M (rewarding team success). The oblique line is probably due to the effect of being drawn over by the second dimension.

The striking feature of both solutions for the Pilot Study and Main Study is that if both charts were to be laid over each other, they are very similar in terms of 'task' and 'responsibility' positions which is a good indication that the data is robust.

APPENDIX D

Anacor Analysis Pilot Study

Pilot Study
U.K. Task/Responsibility Associations Overall Solution

The table to be analyzed:

	1 snrm	2 stcom	3 tmldr	4 tm	Margin
1 A	21	5	12	0	38
2 B	18	4	14	1	37
3 C	25	5	6	1	37
4 D	17	0	15	4	36
5 E	19	15	2	1	37
6 F	3	9	17	9	38
7 G	4	6	23	6	39
8 H	4	5	23	7	39
9 I	2	6	21	11	40
10 J	13	7	18	3	41
11 K	15	9	11	3	38
12 L	11	4	16	6	37
13 M	29	4	7	0	40
Margin	181	79	185	52	497

Dimension	Singular Value	Inertia	Proportion Explained	Cumulative Proportion
1	.50202	.25202	.766	.766
2	.25242	.06372	.194	.960
3	.11536	.01331	.040	1.000
Total		.32905	1.000	1.000

Row Scores:

TASK	Marginal Profile	Dim 1	2
1 A	.076	-.609	.246
2 B	.074	-.367	.365
3 C	.074	-.923	.119
4 D	.072	-.102	.842
5 E	.074	-.796	-1.342
6 F	.076	.848	-.534
7 G	.078	.787	.071
8 H	.078	.847	.173
9 I	.080	1.075	-.091
10 J	.082	.080	.010
11 K	.076	-.207	-.414
12 L	.074	.312	.223
13 M	.080	-1.048	.342

Contribution of row points to the inertia of each dimension:

TASK	Marginal Profile	Dim 1	Dim 2
1 A	.076	.056	.018
2 B	.074	.020	.039
3 C	.074	.126	.004
4 D	.072	.002	.203
5 E	.074	.094	.531
6 F	.076	.110	.086
7 G	.078	.097	.002
8 H	.078	.112	.009
9 I	.080	.185	.003
10 J	.082	.001	.000
11 K	.076	.007	.052
12 L	.074	.014	.015
13 M	.080	.176	.037
		1.000	1.000

Contribution of dimensions to the inertia of each row point:

TASK	Marginal Profile	Dim 1	Dim 2	Total
1 A	.076	.863	.071	.934
2 B	.074	.587	.292	.879
3 C	.074	.958	.008	.966
4 D	.072	.027	.910	.936
5 E	.074	.412	.588	1.000
6 F	.076	.813	.162	.976
7 G	.078	.918	.004	.922
8 H	.078	.961	.020	.981
9 I	.080	.949	.003	.952
10 J	.082	.114	.001	.115
11 K	.076	.328	.661	.990
12 L	.074	.697	.179	.876
13 M	.080	.938	.050	.988

Column Scores:

RESPNBTY	Marginal Profile	Dim 1	Dim 2
1 snrm	.364	-.849	.196
2 stcom	.159	-.057	-1.119
3 tmldr	.372	.541	.319
4 tm	.105	1.115	-.118

Contribution of column points to the inertia of each dimension:

RESPNBTY	Marginal Profile	Dim 1	Dim 2
1 snrm	.364	.523	.056
2 stcom	.159	.001	.789
3 tmldr	.372	.217	.150
4 tm	.105	.259	.006
		1.000	1.000

Contribution of dimensions to the inertia of each column point:

RESPNBTY	Marginal Profile	Dim 1	Dim 2	Total
1 snrm	.364	.968	.026	.994
2 stcom	.159	.005	.982	.987

3 tmldr	.372	.808	.141	.949
4 tm	.105	.882	.005	.887

Variances and Correlation Matrix of the singular values:

Dim	Variances	Correlations between dimensions	
1	.001	1.000	
2	.002	-.073	1.000

Variances and Correlation Matrix of scores of Row 1 A

Dim	Variances	Correlations between dimensions	
1	.008	1.000	
2	.018	.143	1.000

Variances and Correlation Matrix of scores of Row 2 B

Dim	Variances	Correlations between dimensions	
1	.010	1.000	
2	.017	.110	1.000

Variances and Correlation Matrix of scores of Row 3 C

Dim	Variances	Correlations between dimensions	
1	.007	1.000	
2	.019	.172	1.000

Variances and Correlation Matrix of scores of Row 4 D

Dim	Variances	Correlations between dimensions	
1	.028	1.000	
2	.017	-.055	1.000

Variances and Correlation Matrix of scores of Row 5 E

Dim	Variances	Correlations between dimensions	
1	.053	1.000	
2	.025	-.611	1.000

Variances and Correlation Matrix of scores of Row 6 F

Dim	Variances	Correlations between dimensions	
1	.012	1.000	
2	.017	.289	1.000

Variances and Correlation Matrix of scores of Row 7 G

Dim	Variances	Correlations between dimensions	
1	.012	1.000	
2	.030	-.036	1.000

Variances and Correlation Matrix of scores of Row 8 H

Dim	Variances	Correlations between dimensions	
1	.006	1.000	
2	.012	-.226	1.000

Variances and Correlation Matrix of scores of Row 9 I

Dim	Variances	Correlations between dimensions	
1	.011	1.000	
2	.036	.060	1.000

Variances and Correlation Matrix of scores of Row 10 J

Dim	Variances	Correlations between dimensions	
1	.011	1.000	
2	.026	-.009	1.000

Variances and Correlation Matrix of scores of Row 11 K

Dim	Variances	Correlations between dimensions	
1	.006	1.000	
2	.004	-.483	1.000

Variances and Correlation Matrix of scores of Row 12 L

Dim	Variances	Correlations between dimensions	
1	.006	1.000	
2	.010	-.106	1.000

Variances and Correlation Matrix of scores of Row 13 M

Dim	Variances	Correlations between dimensions	
1	.009	1.000	
2	.013	.441	1.000

Variances and Correlation Matrix of scores of Column 1 snrm

Dim	Variances	Correlations between dimensions	
1	.003	1.000	
2	.009	.469	1.000

Variances and Correlation Matrix of scores of Column 2 stcom

Dim	Variances	Correlations between dimensions	
1	.044	1.000	
2	.017	.056	1.000

Variances and Correlation Matrix of scores of Column 3 tmldr

Dim	Variances	Correlations between dimensions	
1	.009	1.000	
2	.011	-.417	1.000

Variances and Correlation Matrix of scores of Column 4 tm

Dim	Variances	Correlations between dimensions	
1	.027	1.000	
2	.074	-.072	1.000

Hi-Res Chart # 1:Row and column scores

APPENDIX E

Anacor Analysis Main Study

Figure 8, U.K. Overall Sample, Task/Responsibility Associations

The table to be analyzed:

	1 snrm	2 stcom	3 tmldr	4 tm	Margin
1 A	80	11	4	1	96
2 B	52	9	61	5	127
3 C	98	11	22	4	135
4 D	47	7	64	12	130
5 E	81	34	10	2	127
6 F	11	13	73	39	136
7 G	12	4	94	25	135
8 H	16	13	83	19	131
9 I	11	17	72	35	135
10 J	35	27	66	10	138
11 K	45	31	49	14	139
12 L	45	10	67	11	133
13 M	89	6	26	2	123
Margin	622	193	691	179	1685

Dimension	Singular Value	Inertia	Proportion Explained	Cumulative Proportion
1	.55762	.31095	.815	.815
2	.21856	.04777	.125	.940
3	.15121	.02286	.060	1.000
Total		.38158	1.000	1.000

Row Scores:

TASK	Marginal Profile	Dim 1	2
1 A	.057	-1.321	.099
2 B	.075	-.091	.431
3 C	.080	-.969	.307
4 D	.077	.099	.443
5 E	.075	-1.007	-.903
6 F	.081	.927	-.196
7 G	.080	.933	.469
8 H	.078	.717	.077
9 I	.080	.864	-.342
10 J	.082	.174	-.449
11 K	.082	-.036	-.712
12 L	.079	.124	.325
13 M	.073	-.925	.558

Contribution of row points to the inertia of each dimension:

TASK	Marginal Profile	Dim 1	2
1 A	.057	.178	.003
2 B	.075	.001	.064
3 C	.080	.135	.034
4 D	.077	.001	.069
5 E	.075	.137	.281
6 F	.081	.124	.014
7 G	.080	.125	.081
8 H	.078	.072	.002
9 I	.080	.107	.043
10 J	.082	.004	.076
11 K	.082	.000	.191
12 L	.079	.002	.038
13 M	.073	.112	.104
		1.000	1.000

Contribution of dimensions to the inertia of each row point:

TASK	Marginal Profile	Dim 1	Dim 2	Total
1 A	.057	.971	.002	.974
2 B	.075	.061	.541	.601
3 C	.080	.938	.037	.975
4 D	.077	.107	.846	.953
5 E	.075	.759	.239	.999
6 F	.081	.835	.015	.849
7 G	.080	.909	.090	.999
8 H	.078	.944	.004	.948
9 I	.080	.862	.053	.915
10 J	.082	.146	.381	.527
11 K	.082	.006	.949	.955
12 L	.079	.202	.539	.741
13 M	.073	.867	.123	.990

Column Scores:

RESPNBTY	Marginal Profile	Dim 1	Dim 2
1 snrm	.369	-.900	.188
2 stcom	.115	-.191	-1.241
3 tmldr	.410	.610	.239
4 tm	.106	.978	-.235

Contribution of column points to the inertia of each dimension:

RESPNBTY	Marginal Profile	Dim 1	Dim 2
1 snrm	.369	.536	.059
2 stcom	.115	.007	.807
3 tmldr	.410	.274	.107
4 tm	.106	.182	.027
		1.000	1.000

Contribution of dimensions to the inertia of each column point:

RESPNBTY	Marginal Profile	Dim 1	Dim 2	Total
1 snrm	.369	.979	.017	.995
2 stcom	.115	.055	.907	.962
3 tmldr	.410	.896	.054	.950
4 tm	.106	.770	.017	.787

Variances and Correlation Matrix of the singular values:

Dim	Variances	Correlations between dimensions	
1	3.091E-04	1.000	
2	6.330E-04	-.022	1.000

Variances and Correlation Matrix of scores of Row 1 A

Dim	Variances	Correlations between dimensions	
1	.002	1.000	
2	.019	.033	1.000

Variances and Correlation Matrix of scores of Row 2 B

Dim	Variances	Correlations between dimensions	
1	.004	1.000	
2	.019	.005	1.000

Variances and Correlation Matrix of scores of Row 3 C

Dim	Variances	Correlations between dimensions	
1	.002	1.000	
2	.011	.118	1.000

Variances and Correlation Matrix of scores of Row 4 D

Dim	Variances	Correlations between dimensions	
1	.002	1.000	
2	.002	-.059	1.000

Variances and Correlation Matrix of scores of Row 5 E

Dim	Variances	Correlations between dimensions	
1	.006	1.000	
2	.005	-.432	1.000

Variances and Correlation Matrix of scores of Row 6 F

Dim	Variances	Correlations between dimensions	
1	.005	1.000	
2	.058	.049	1.000

Variances and Correlation Matrix of scores of Row 7 G

Dim	Variances	Correlations between dimensions	
1	.002	1.000	
2	.002	-.510	1.000

Variances and Correlation Matrix of scores of Row 8 H

Dim	Variances	Correlations between dimensions	
1	.002	1.000	
2	.011	-.076	1.000

Variances and Correlation Matrix of scores of Row 9 I

Dim	Variances	Correlations between dimensions	
1	.003	1.000	
2	.028	.110	1.000

Variances and Correlation Matrix of scores of Row 10 J

Dim	Variances	Correlations between dimensions	
1	.006	1.000	
2	.038	-.049	1.000

Variances and Correlation Matrix of scores of Row 11 K

Dim	Variances	Correlations between dimensions	
1	.004	1.000	
2	.006	-.119	1.000

Variances and Correlation Matrix of scores of Row 12 L

Dim	Variances	Correlations between dimensions	
1	.002	1.000	
2	.007	-.036	1.000

Variances and Correlation Matrix of scores of Row 13 M

Dim	Variances	Correlations between dimensions	
1	.003	1.000	
2	.006	.220	1.000

Variances and Correlation Matrix of scores of Column 1 snrm

Dim	Variances	Correlations between dimensions	
1	8.745E-04	1.000	
2	.003	.312	1.000

Variances and Correlation Matrix of scores of Column 2 stcom

Dim	Variances	Correlations between dimensions	
1	.013	1.000	
2	.015	-.003	1.000

Variances and Correlation Matrix of scores of Column 3 tmldr

Dim	Variances	Correlations between dimensions	
1	.002	1.000	
2	.007	-.230	1.000

Variances and Correlation Matrix of scores of Column 4 tm

Dim	Variances	Correlations between dimensions	
1	.008	1.000	
2	.090	-.052	1.000

Hi-Res Chart # 1:Row and column scores

APPENDIX F

Comparison of U.K. Stratified Data and U.S. Data

20 Jun 96 SPSS for MS WINDOWS Release 6.0
Page 1

t-tests for independent samples of BUSINESS

Variable	Number of Cases	Mean	SD	SE of Mean
SALES				
BUSINESS 1	133	3.8872	1.555	.135
BUSINESS 2	70	4.9143	1.151	.138

Mean Difference = -1.0271

Levene's Test for Equality of Variances: F= 16.128 P= .000

	t-test for Equality of Means				95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Equal	-4.87	201	.000	.211	(-1.443, -.611)
Unequal	-5.33	178.91	.000	.193	(-1.407, -.647)

t-tests for independent samples of BUSINESS

Variable	Number of Cases	Mean	SD	SE of Mean
PLC				
BUSINESS 1	122	57.9836	46.332	4.195
BUSINESS 2	69	55.4203	49.334	5.939

Mean Difference = 2.5633

Levene's Test for Equality of Variances: F= .025 P= .876

	t-test for Equality of Means				95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Equal	.36	189	.720	7.145	(-11.534, 16.661)
Unequal	.35	134.02	.725	7.271	(-11.821, 16.947)

t-tests for independent samples of BUSINESS

Variable	Number of Cases	Mean	SD	SE of Mean
MGROWTH				
BUSINESS 1	121	23.2893	37.549	3.414
BUSINESS 2	70	16.6571	17.693	2.115

Mean Difference = 6.6321

Levene's Test for Equality of Variances: F= 6.937 P= .009

	t-test for Equality of Means				95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Equal	1.39	189	.166	4.771	(-2.782, 16.046)
Unequal	1.65	182.93	.100	4.016	(-1.292, 14.557)

t-tests for independent samples of BUSINESS

Variable	Number of Cases	Mean	SD	SE of Mean
MSHARE				
BUSINESS 1	121	26.8926	23.298	2.118
BUSINESS 2	70	36.8857	23.924	2.859

Mean Difference = -9.9932

Levene's Test for Equality of Variances: F= .895 P= .345

t-test for Equality of Means					95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Equal	-2.83	189	.005	3.533	(-16.964, -3.022)
Unequal	-2.81	141.07	.006	3.558	(-17.029, -2.957)

t-tests for independent samples of BUSINESS

Variable	Number of Cases	Mean	SD	SE of Mean
RDSPEND				
BUSINESS 1	125	9.9416	9.947	.890
BUSINESS 2	70	11.1286	9.966	1.191

Mean Difference = -1.1870

Levene's Test for Equality of Variances: F= 1.312 P= .253

t-test for Equality of Means					95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Equal	-.80	193	.425	1.486	(-4.119, 1.745)
Unequal	-.80	142.74	.426	1.487	(-4.127, 1.753)

APPENDIX G

An Example of Correlations and Regressions of Product Market with Task Autonomy Variables

Correlations and Regressions on Product Market Variables and Tasks

A more quantitative method of investigating relationships between product market and task autonomy variables can be achieved through the use of correlations and linear regressions. Two types of correlation are possible, Pearson and Spearman Rank. Spearman Rank correlations were used since data in Question 8, in the form of a Likert scale, is not completely normal. There is a slight skew in some of the data and therefore the more conservative approach using Spearman Rank correlations is preferred. Correlations were run on the U.K. Electrical/Electronics/Software group of companies (133 cases) with the following relationships noted.

	Team Selection (A)		Team deselection (B)		Budget Setting (C)		Budget Spending (D)		Rewarding Team Success (M)	
	sig	'r'	sig	'r'	sig	'r'	sig	'r'	sig	'r'
SALES					.015	.2115			.001	.2734
MGROWTH			.003	.2689						

Relationship of Demographic Variables to Task Autonomy in U.K. Electrical/Electronics/Software Companies

As may be seen from the data sales is significantly related to both 'budget setting' and 'rewarding team success', and 'market growth' has a positive, significant relationship with 'team de-selection'. Further research into establishing any causal effects could be an interesting area. The full correlation analysis may be found below.

UK ELECTRICAL\ELECTRONICS\SOFTWARE COMPANIES 133 CASES

\- - - S P E A R M A N C O R R E L A T I O N C O E F F I C I E N T S -

PLC	.1202				2-tailed Significance	
	N(122)					
	Sig .187					
MGROWTH	-.2041	-.2543				
	N(121)	N(119)				
	Sig .025	Sig .005				
MSHARE	.2362	-.0544	.0082			
	N(121)	N(118)	N(119)			
	Sig .009	Sig .559	Sig .929			
RDSPEND	-.2559	.0130	.1823	-.1716		
	N(125)	N(118)	N(118)	N(117)		
	Sig .004	Sig .889	Sig .048	Sig .064		
Q8A	.1224	-.0379	.1167	-.0236	.0023	
	N(133)	N(122)	N(121)	N(121)	N(125)	
	Sig .160	Sig .679	Sig .202	Sig .797	Sig .979	
Q8B	.0582	.0484	.2689	-.0159	.0253	.6378
	N(133)	N(122)	N(121)	N(121)	N(125)	N(133)
	Sig .505	Sig .597	Sig .003	Sig .863	Sig .779	Sig .000
Q8C	.2115	.1027	-.0855	.0574	-.0558	.2903
	N(133)	N(122)	N(121)	N(121)	N(125)	N(133)
	Sig .015	Sig .260	Sig .351	Sig .532	Sig .537	Sig .001
Q8D	.1328	.1498	-.0731	.0421	.0943	.2606
	N(133)	N(122)	N(121)	N(121)	N(125)	N(133)
	Sig .128	Sig .100	Sig .426	Sig .647	Sig .296	Sig .002
	SALES	PLC	MGROWTH	MSHARE	RDSPEND	Q8A
Q8E	-.0172	-.1018	.1293	.0457	.0085	.4343

	N(133)	N(122)	N(121)	N(121)	N(125)	N(133)
	Sig .844	Sig .265	Sig .157	Sig .619	Sig .925	Sig .000
Q8M	.2734	-.1233	.0658	.0966	.1377	.3919
	N(133)	N(122)	N(121)	N(121)	N(125)	N(133)
	Sig .001	Sig .176	Sig .473	Sig .292	Sig .126	Sig .000
	SALES	PLC	MGROWTH	MSHARE	RDSPEND	Q8A

Care should be exercised when interpreting correlation data. Correlation does not imply causation. If the variables are correlated, this may be because 'X' causes 'Y', or because 'Y' causes 'X', or because some other variable is affecting both X and Y, or for a mixture of these reasons; or the whole relationship may be a coincidence. Sometimes it is possible to find agreement with categorical and interval type data, but not always since this categorical data is not weighted. An inspection of chart 6 shows a measure of agreement with budget spending (B) and rewarding team success (M). There is movement in task location B $\Rightarrow$ B1 which tends to reverse direction, but we do not know at which sales level this occurs. M $\Rightarrow$ M1 moves in the direction of the team leader, albeit quite small and there is no means of determining at which sales level this may increase or how much the type of company might influence the result. Nevertheless, movement of this degree needs to be explained.

One means controlling for the influence of one variable is by applying the technique of partial correlation which allows for the influence of one or more of the variables on the others. A table for partial correlation allowing for 'business' type found below indicates a closer relationship to chart 6. However, it should be noted that partial correlations using SPSS are Pearson Product Moment correlations and therefore less conservative.

- P A R T I A L C O R R E L A T I O N C O E F F I C I E N T S -

Controlling for.. BUSINESS, Single Tail Test

	Q8A	Q8B	Q8C	Q8D	Q8E	Q8M
SALES	.1555	.0898	.2322	.1587	-.0239	.2884
	(130)	(130)	(130)	(130)	(130)	(130)
	P= .038	P= .153	P= .004	P= .035	P= .393	P= .000

- - - P A R T I A L C O R R E L A T I O N C O E F F I C I E N T S - -

Controlling for.. BUSINESS, Two Tail Test

	Q8A	Q8B	Q8C	Q8D	Q8E	Q8M
SALES	.1555	.0898	.2322	.1587	-.0239	.2884
	(130)	(130)	(130)	(130)	(130)	(130)
	P= .075	P= .306	P= .007	P= .069	P= .786	P= .001

(Coefficient / (D.F.) / 2-tailed Significance)

" . " is printed if a coefficient cannot be computed

When controlled for 'business', sales appears to be associated with team selection, budget setting/spending and rewarding team success (A,C,D,M) indicating a closer agreement with chart 6. Although the single tail test shows a higher significance for team selection and budget spending, there is an overall close agreement. A more rigorous technique for determining causality is regression analysis.

Regression Analysis

Using regression analysis it is possible to analyse the data from question 8 for causal relationships because the ordinal type of Likert scale resembles interval data since it has a monotonic scale. Using the demographic variables a forward stepwise regression analysis was run against the individual autonomy variables.

Stepwise Multiple Regressions of Sales and R&D Spending on Rewarding Team Success (Q8M)

U.K. Electrical/Electronics/Software Group.

* * * * M U L T I P L E R E G R E S S I O N * * * *

Listwise Deletion of Missing Data

Equation Number 1 Dependent Variable.. Q8M

Block Number 1. Method: Stepwise Criteria PIN .0500 POUT .1000
SALES RDSPEND

Variable(s) Entered on Step Number
1.. SALES

Multiple R	.24412
R Square	.05959
Adjusted R Square	.05195
Standard Error	1.71016

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	22.79611	22.79611
Residual	123	359.73189	2.92465

F = 7.79447 Signif F = .0061

---------- Variables in the Equation ----------

Variable	B	SE B	Beta	T	Sig T
SALES	.275342	.098623	.244117	2.792	.0061
(Constant)	2.512079	.410632		6.118	.0000

---------- Variables not in the Equation ----------

Variable	Beta In	Partial	Min Toler	T	Sig T
RDSPEND	.279273	.273722	.903397	3.143	.0021

Equation Number 1 Dependent Variable.. Q8M

Variable(s) Entered on Step Number
2.. RDSPEND

Multiple R	.36063
R Square	.13005
Adjusted R Square	.11579
Standard Error	1.65157

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	49.74861	24.87430
Residual	122	332.77939	2.72770

F = 9.11915 Signif F = .0002

```
---------- Variables in the Equation ----------

Variable            B        SE B       Beta          T  Sig T

SALES            .373245     .100208    .330918     3.725  .0003
RDSPEND          .049311     .015687    .279273     3.143  .0021
(Constant)      1.643551     .483328                3.400  .0009

End Block Number   1   POUT =     .100 Limits reached.
```

The results demonstrate that, individually, both sales and R&D spending regress onto rewarding team success (M), giving an R Square value of 0.13, indicating that sales and R&D spending are predictors of the degree of autonomy that team leaders have for the task, 'rewarding team success'. . Even though this value only accounts for 13% of the variance it indicates that a relationship does exist and needs to be explained. More research would be needed to establish the product market variable conditions under which team leader autonomy is granted.

Team leader autonomy appears to be very complex. In general the product market, and team leader autonomy data would lend itself to further analysis, but is beyond the scope of this work.

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